

FIRST '82 CARS: Ford downsizes Continental, adds muscle to Mustang

SEPTEMBER 1981 \$1.25

Popular Mechanics

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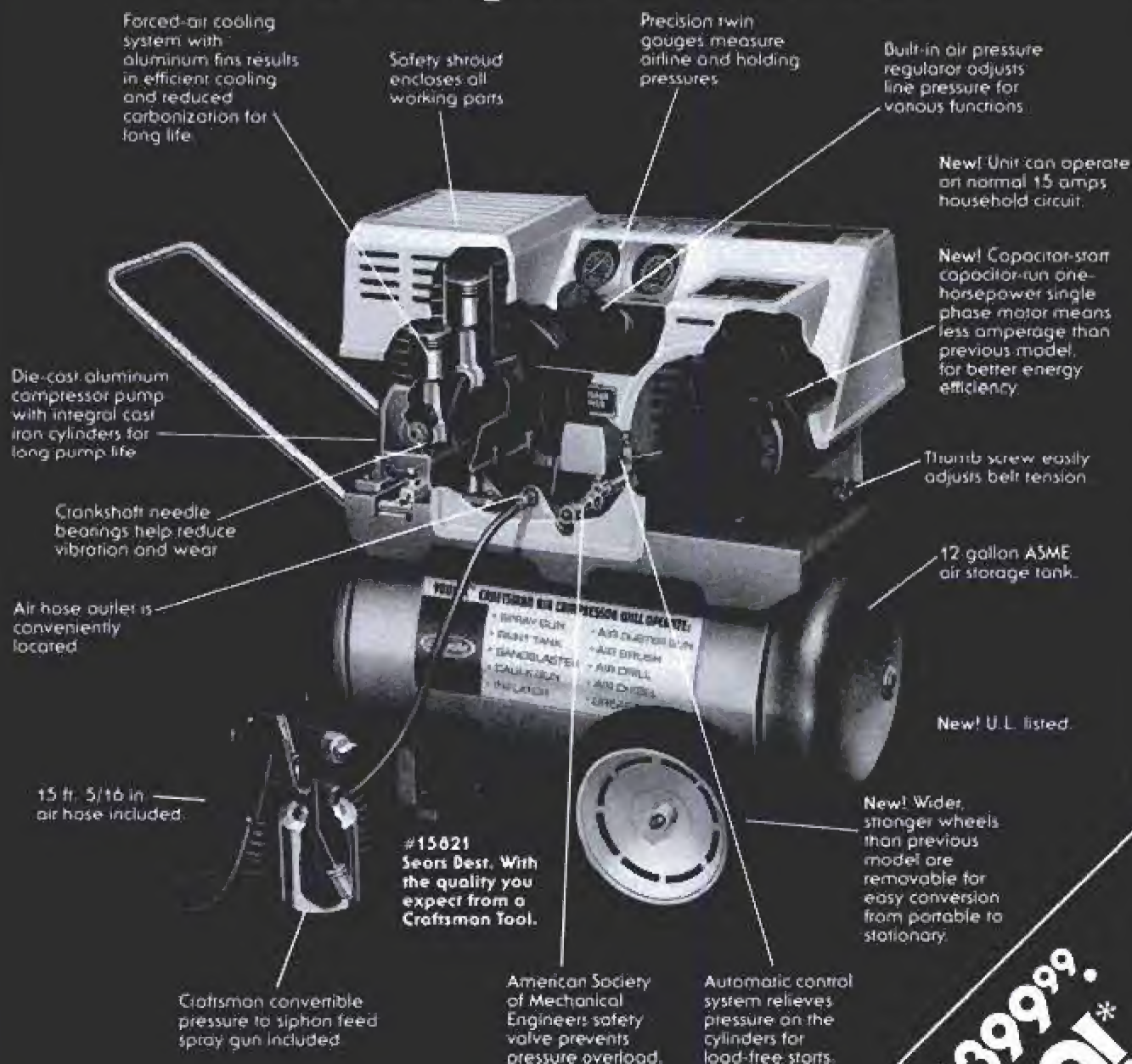
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On the cover

An F-15 fighter leaps into the air in a retaliatory strike, while fires from a successful enemy attack to wipe out its base are still burning. How can it happen? The U.S. Air Force thinks a passive "hovercraft" platform might change the strategy of air war. Story on page 92.
—PM painting by Ed Valigursky

Popular Mechanics

SEPTEMBER 1981

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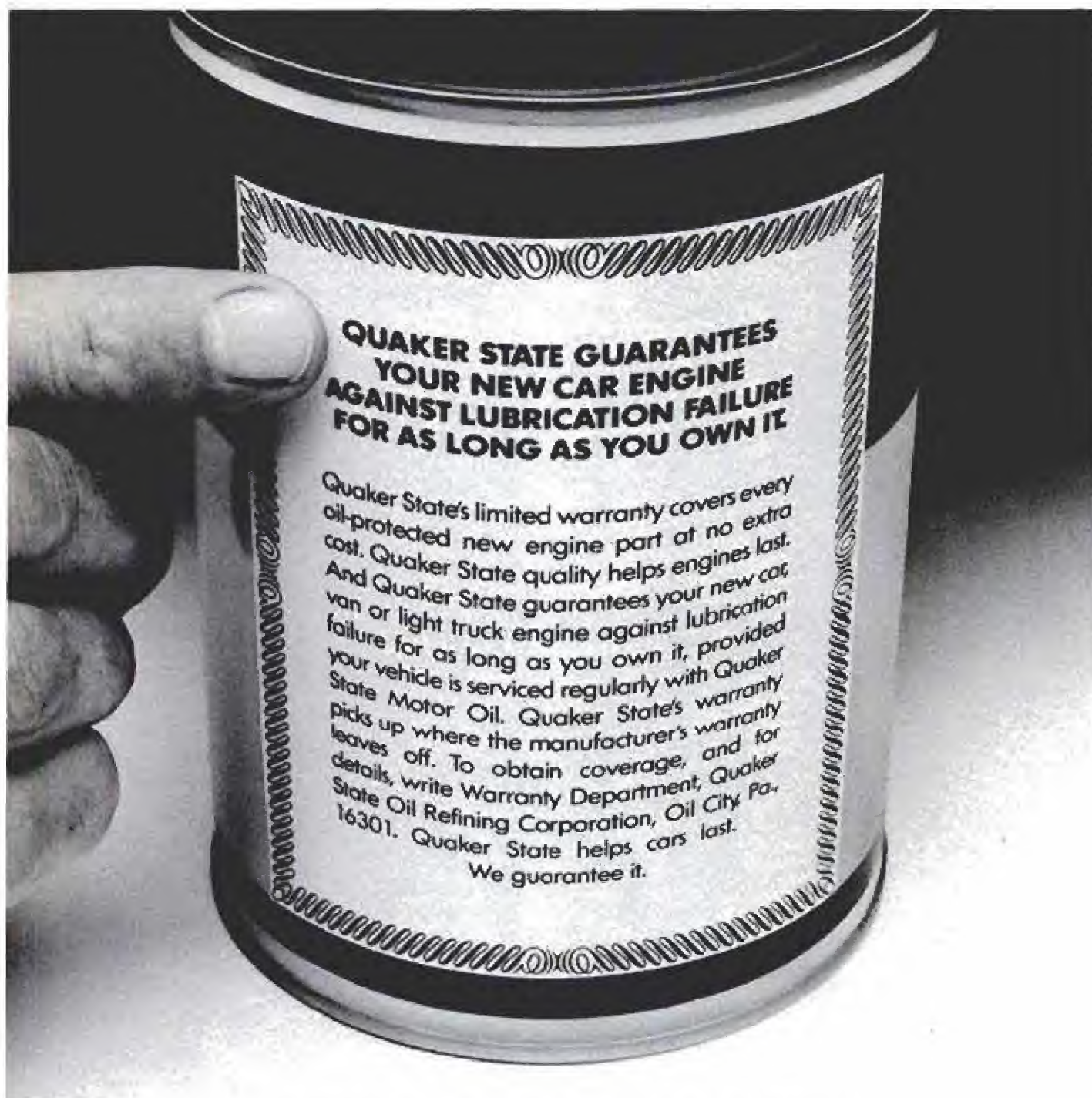
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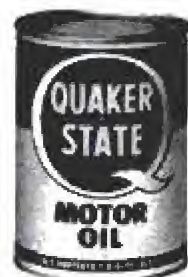


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LETTERS TO THE EDITOR

Some people bought 'em

Congratulations on your article *The Economy Cars America Never Bought* (page 63, July '81). It's about time that a major publication printed the facts. The car-buying public finds it handy to criticize the auto industry, but it really has only itself to blame.

THEODORE J. DOMBROWSKI
DETROIT

Nice article, but you omitted a car that quite a few people actually did buy—the King Midget.

HALBERT F. SPEER
SEA CLIFF, N.Y.

How come you left out the 1972 Honda Coupe? This two-cylinder wonder is one of the finest small cars still on the road today.

ANDREA JAY
STATEN ISLAND, N.Y.

Auto editor Tony Assenza replies: *No slight intended. The cars we picked were those that had major corporate backing and were produced in significant numbers. The Honda Coupe was largely an experiment and was never really pushed. The King Midget, while it did sell in small numbers, was a very limited-production vehicle.*

Two cool ideas

I was intrigued by your article *10 Ways to Cool Your Home Without an Airconditioner* (page 88, July '81). Here are two more ideas that might interest other readers:

We have a brick-walled addition on one side of the house. I find that if I hose down the bricks on hot days (assuming no water shortage), the evaporation of the moisture by the sun cools down the interior by 10° to 15°.

We considered awnings, but instead I put up a trellis along the house and grew grape vines on it. It's an automatic heat control. In summer, the leaves provide cooling shade; in winter, the bare vines let in the sun for warmth. And you also get to eat the grapes!

AL MONYER
RAHWAY, N.J.

Grounded garbage cans

In your June '81 issue, you show an in-ground garbage can (*5 Conveniences You Can Add to Your Yard*,

page 114). Here in San Leandro, as in many other communities, garbage collectors are exempted by law from emptying in-ground cans because of the many back injuries that have resulted from lifting the heavy containers. I think you should tell your readers about this.

E. W. SOUZA
SAN LEANDRO, CALIF.

Yes, that's true, but the container we showed is intended merely as a homeowner convenience to conceal trash and protect it from animals between collections. It is a light, easily handled pail, not a full-size can. As it fills, its contents must, of course, be transferred to larger containers at the street or elsewhere.

Tale of two clocks

I am enclosing a photo (below) of the mahogany mantel clock I built from plans in your February '81 issue (*A Lincoln Legacy: Two Mantel Clocks You Can Build*, page 130). All the



PM's reproduction of historic Lincoln mantel clock, as built by reader Jacobsen.

work went well and I am now in the process of making several more clocks for gifts.

My compliments to PM for this fine woodworking project.

B. L. JACOBSEN
SOUTH CHATHAM, MASS.

I ordered the kit for the crystal mantel clock (*More Heirloom Clocks from Kits*, page 134, Feb. '81). When the kit arrived—lo and behold—it contained no clock movement, only

the wood and glass. I think you made a boo-boo.

PHILLIP W. O'SHEA
ERIE, COLO.

We should have made it clear that the kit did not include the movement. This is part No. 3398X and is an additional \$58.50 from Mason & Sullivan, 39 Blossom Ave., Osterville, Mass. 02655.

Easier geometric shapes

In your item on drawing geometric shapes (*4 Better Ways in Your Shop*, page 84, July '81), you say to multiply the constants by the diameter of the circle in inches, then to transfer the measurements with an engineer's rule. But your answers will be in hundredths of an inch, and an engineer's rule is in hundredths of a foot. Thus, you must first multiply each measurement by a conversion factor of .0833 to change it into hundredths of a foot.

This can be avoided if you multiply the constants, which are in hundredths, by the diameter of the circle in hundredths of a foot. The measurements can then be read directly on an engineer's rule.

ERNEST PONTES
BAY SHORE, N.Y.

A good tip if you're working with a rule marked only in hundredths of a foot and if you can conveniently lay out your circle in hundredths of a foot to begin with. However, many engineer's rules have scales marked in tenths and hundredths of an inch. Using one, you can keep your measurements in inches and avoid conversions.

Egad, female computers!

Thank you for the review of our speech synthesizer for home computers (*Tech Front Lines*, page 103, June '81). It's true that the present system is a bit cumbersome and time-consuming, but this will soon be remedied in our upgraded models, which will allow normal English text to be translated into speech automatically. Female speech will also be available.

We'd like to point out that the price for our current synthesizer is \$225, not \$275 as reported.

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Isuzu eye-opener



Isuzu Piazza with two-liter, single-overhead-cam Four gets 120 hp, with dohc, 135 hp.

If you like real sports cars, you probably didn't pay much attention to the line of cars Isuzu introduced here earlier this year (see *Driving the Isuzu I-Mark and P'up*, page 73, July '81): not bad-looking, terrific diesel fuel mileage, right price, but short on the pizzazz. The Piazza, however, is something else. The new, gently wedged sports car is a real eye-opener (I-Opener?). The body swoops back from the sharp nose to the rounded rear which is

Sports Assn. (IMSA) GTU circuit. Rebounding around a racetrack could ding up the Le Car Turbo, so Renault's manager of competition, Patrick Jacquemart, who midwived the one-of-a-kind, road-racing, yellow turbo into the world, is doing the driving himself. In the under-two-liter class (GTU), the Le Car is way under—1.4 liters, and running against cars with 2.2 to 2.5 liters like the Datsun Zs and Mazda RX-7s. This almost-ferocious-looking Le Car, its cuteness incognito, is an underdog you love to root for.

Gee-em-whizzer

It'll be an Opel in Europe, a Vauxhall in Britain and a GM Something-or-other when it finally arrives here. The GM S-car, caught in this sneak shot in Europe, will threaten the



Resemblance at tallights is Porsche 928.

reminiscent of the Porsche 928; overall, however, the Piazza looks more like a Japanese stepbrother of VW's new Scirocco. The I-Opener (why not!) is built on a 96-in. wheelbase, is 170 in. overall, 65 in. wide and 51 in. high. It's now on sale in Japan and is expected here late this year or early next. No diesel in this one: Choice is between a pair of two-liter Fours, one with single overhead cam, the other with dohc.

Le Carom

That's awfully pretty bodywork to be out on the International Motor



GM S-car is still way down the road for us.

market shares of a lot of popular little cars—like Polos, Metros, R5s, et al.—when it goes on sale about a year from now. GM president F. James McDonald declares that the mini won't be here before mid-1984. That's a long wait for the sophisticated S—a "domestic" car that might help dislodge Honda's Civic from its tight hold on the sporty, mini-muscle, car-enthusiast segment of the market. Actually, the S-car will be built in a new plant in Spain, at least initially. There will be hatchback and notchback versions of the four-seater, both on a 92.2-in. wheelbase. The car's four-cylinder-

engine choices in Europe will range from a one-liter, 40-hp unit, to a 1.4-liter, 75-hp, high-torque whizz-banger. Oh, well, sit tight, only three more years of wheezing around in your Chevette.

Volvo 400 Series

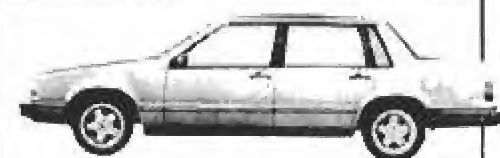
I knew if I waited long enough my 145S Volvo wagon, which is in a coma and waiting for me to rebuild and restore it, would slowly oxidize



New Volvos stick with rear-wheel drive.

into a classic. It's a step closer to antique plates now that Volvo has shown its 400 Series. The 400 models will replace the 200 Series next year in Europe, and come here in 1983. The 442 will be the four-cylinder, two-door; the 444, the four-door and the 445 the five-door wagon.

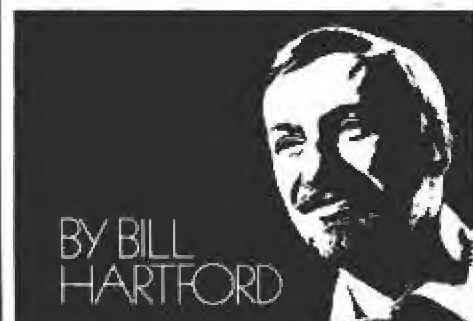
If you think you've seen the sharp edges of the 444, shown here, somewhere before, you're right: The Volvo Concept Car (see *Imports & Motorsports*, page 30, June '80) paved the way for the 400 Series. The nose (long enough for an in-line diesel Six) is almost identical and so is the passenger compartment. Under the hood, we suspect that turbo-charging will extend to more of the strait-laced sedans and not be reserved only for the matte-black, air-dammed GTs.



New designation for the four-door is 444.

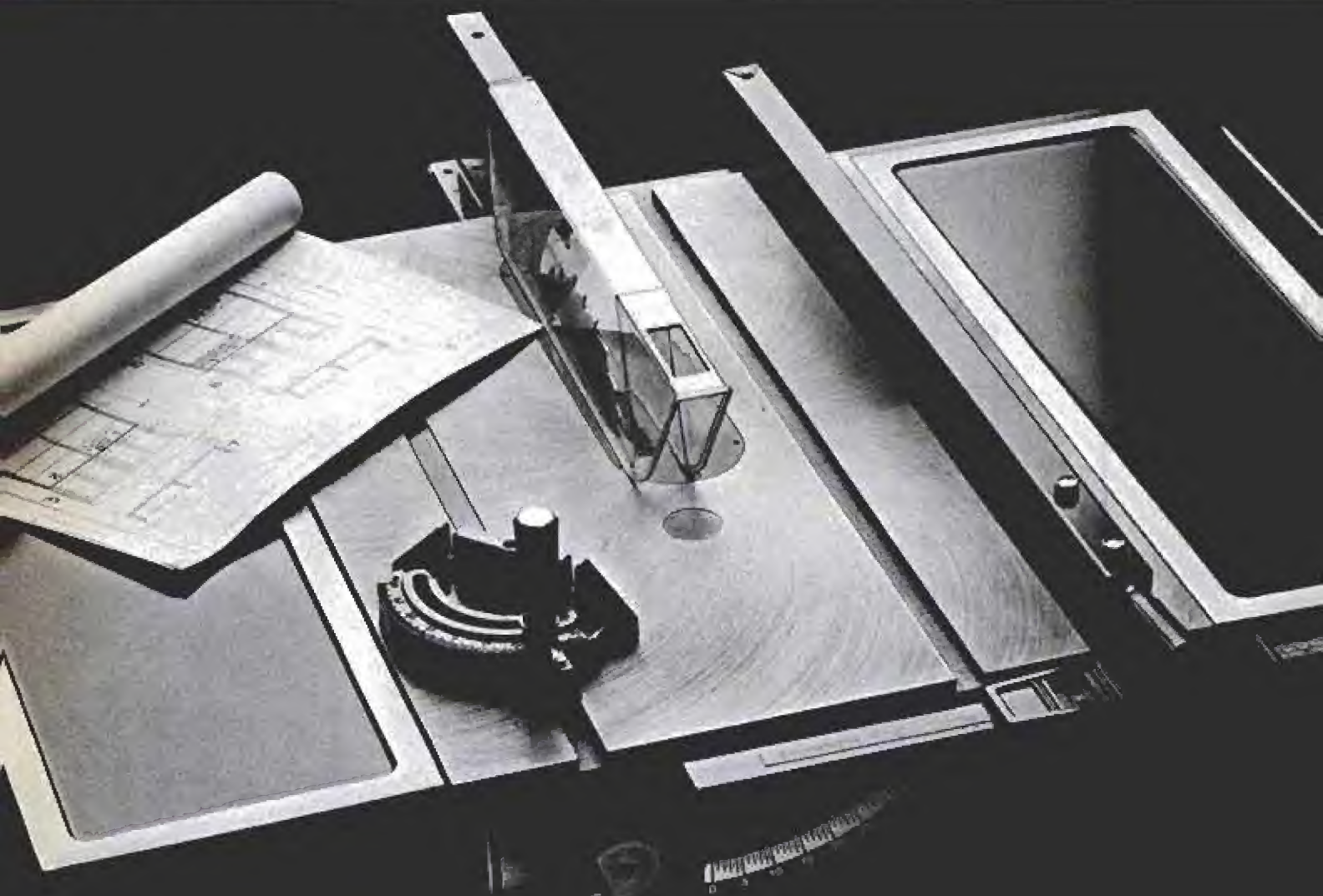


Le Car Turbo is Renault's GTU challenger.



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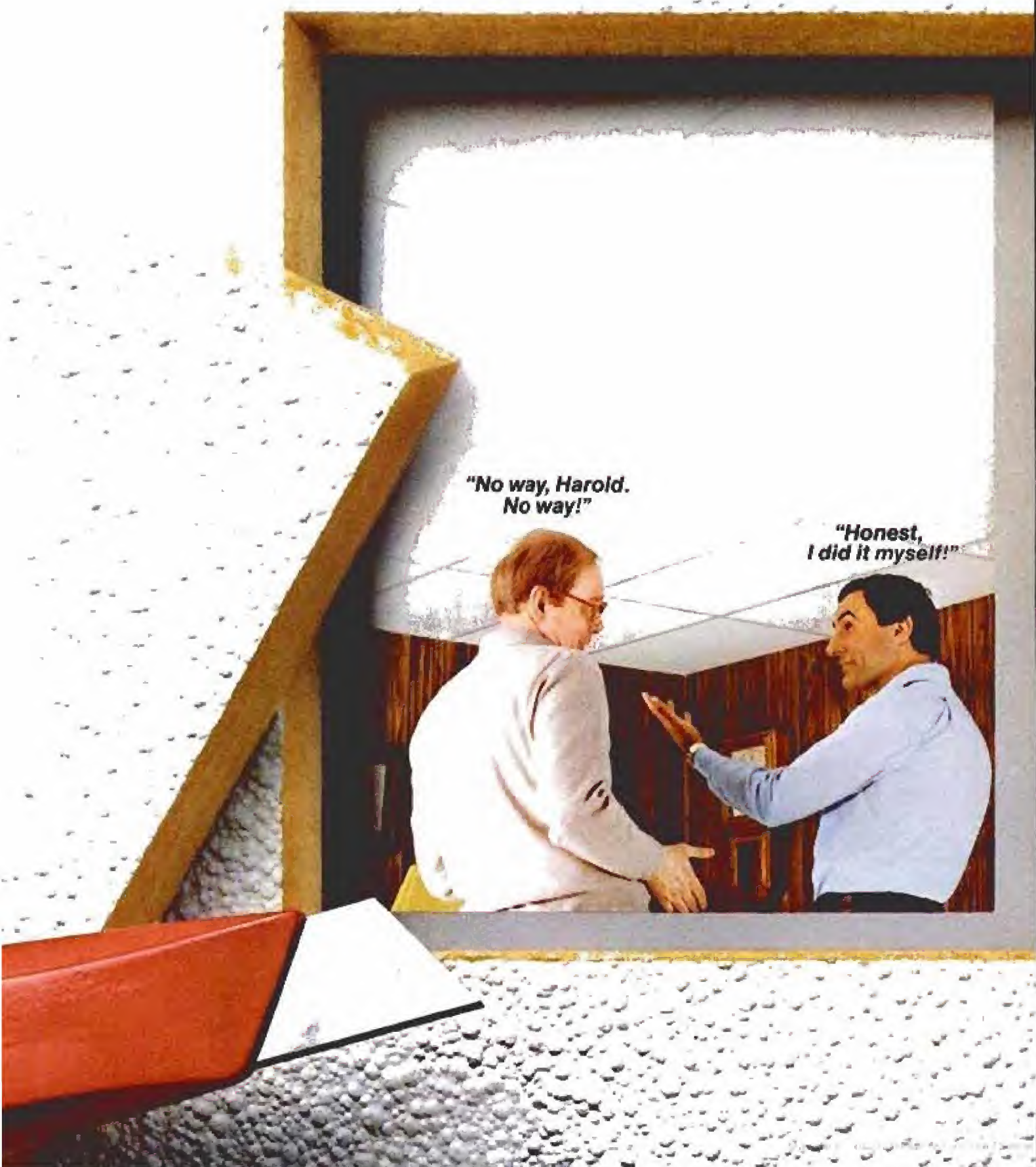
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NOTES FROM THE EDITOR

John A. Sallat

"If I had been designing cars in the United States, I would have done just what American designers did—I'd have made large cars."

That statement by famed Italian auto designer Sergio Pininfarina is all the more surprising because he is the builder of the most aerodynamically perfect car body yet—the "banana car" (see *Searching for the Perfect '10*, page 75).

During an interview with Auto Editor Tony Assenza and me, Pininfarina cited the American automobiles that we have now come to characterize as "gas-guzzlers, dinosaurs and behemoths."

"You have become too critical of your cars, and you're too severe in judging Detroit designers and builders. You Americans have vast distances to drive, your gasoline—at one time—was very inexpensive, and you really like big cars. I would have built big cars."



Designer Sergio Pininfarina shows a photo of his "banana car" to Auto Editor Assenza and me.

Speaking of the cars from Detroit, you're going to find that the 1982 models will be introduced over the longest period of time ever. No longer is the unveiling of the new cars the single Big Event of autumn. Ford comes first this year (page 89), and there'll be something new almost every month until April when Chrysler shows the LeBaron convertible. So that you can tell what comes when, we've prepared a complete schedule on page 88.



John Pearson monitors the "golf ball," a pressure chamber that simulates ocean depth to 3,600 feet.

Writer John Pearson passed up an inside look at Duke University's claustrophobic pressure chamber.

However, now he's wondering if he missed a memorable experience. John was there when three volunteer "divers" emerged after 43 days at record pressures (page 80). All had experienced vivid dreams of "floating off into space . . . swooping and soaring."

Can you imagine—a deep-sea disco, John now muses. **PM**

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The NTS/Rockwell AIM 65 Microcomputer (#2) is included in our Microprocessor Technology Course. It's a single board unit featuring an on-board 20 column alphanumeric printer with 20 character display. This 6502-based unit also has 4K RAM memory, expandable, 8K monitor ROM and 8K advanced BASIC interpreter on ROM.

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QUESTIONS ANSWERED

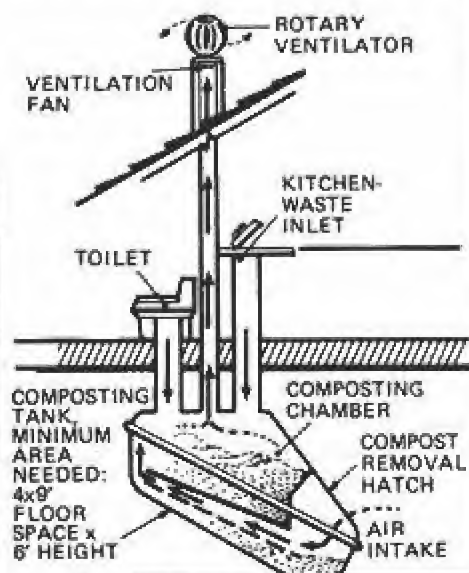
Waste disposal systems

In "Alternate to Septic Tank" (*Homeowners' Clinic*, page 20, Sept. '81) I neglected to mention two other methods of on-site sewage disposal. Many readers brought this to my attention, but Walter Fielding of Akron, Ohio, put it most succinctly when he wrote, "You blew it."

One system still uses a septic tank, but provides for effluent absorption and treatment through a mound of sand of known hydraulic properties. Solids settle out in the septic tank, but a pump pressurizes the effluent and elevates it to a distribution network in the mound of sand. Waste waters pass through the sand and infiltrate the soil gradually. Mounds are suggested in regions with soils of low porosity or where ground water or bedrock make subsurface absorption unsuitable for leaching.

The Small Scale Waste Management Project of the University of Wisconsin has done extensive work on mounding systems. For a list of publications on the subject, write: Small Scale Waste Management Project, 1 Agricultural Hall, 1450 Linden Drive, Madison, Wis. 53706.

The second method of sewage disposal I neglected to mention is known as the compost system. It relies on the natural, organic decomposition of wastes, requires no water for flushing, and ultimately produces compost that is good for use on plants. Clivus Multrum USA, 14-A Elliot St., Cambridge, Mass.



Kitchen and toilet waste collect in the compost chamber of this unit, made by Clivus Multrum, then decompose into compost.

02138, is one of several manufacturers of composting systems (see drawing). Kitchen and toilet wastes go via separate chutes into the tank, which is located in the basement. The manufacturer claims that a ventilating shaft assures odor-free operation.

Composting systems are just an alternative now, but they may become a necessity in the future if water shortages and soil saturation become a reality. A Clivus Multrum unit for home use begins at about \$3,200. Write the company for its illustrated brochure and the name of the dealer nearest you.

Water heater for wood stove

The wood stove I just installed heats about 2,000 sq. ft. of living area. I would now like to install a coil inside



Holly Hydro heater fits in a wood stove or fireplace and is hooked up to the domestic water system to heat the water.

the stove to preheat my house's water. Ports in the side of the stove will accept a 1-in. pipe. What type and size piping will I need? As I intend to store the heated water in the holding tank prior to sending it through my water heater, what type of valves are needed to direct the water flow?

—Denton Hushaw, Salem, Mo.

The Holly Hydro heater may be what you need. The maker calls it a water jacket. It's made of 1/4-in. mild steel and has connections for 3/4-in. dia. pipe. When placed in a woodstove or fireplace and connected to the house water system, the unit will save you money on your hot-water fuel bill.

These economical units are 2 in. thick by 6 in. high, and are available

Do you have a home maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send order(s) to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.

in 12-, 14-, 18- or 24-in. lengths. The units are designed to fit on edge—down one side wall inside the stove or across the back wall, for example. They can be installed outside the stove; however, that cuts production by two-thirds. Hourly B.T.U. output varies from approximately 15,000 to 30,000, depending on the size of the unit.

The manufacturer claims that a do-it-yourself plumber can install the unit, including a hookup to an existing hot-water tank.

The jacket varies in price from \$90 to \$115, depending upon unit size and geographical location of the dealer. For more information, write: Holly Hydro Heater, Box 339, Sebastopol, Calif. 95472.

Extra vapor barrier

I intend to remove the old lath and plaster from three of my bedroom walls and install insulation with its own vapor barrier. Would there be any advantage or disadvantage to installing an additional 2-mil plastic vapor barrier on top of this?

—Roger Short, Pittsburgh.

There would be no disadvantage. A probable advantage would be that your additional barrier may cover any holes or gaps in the barrier of your insulation.

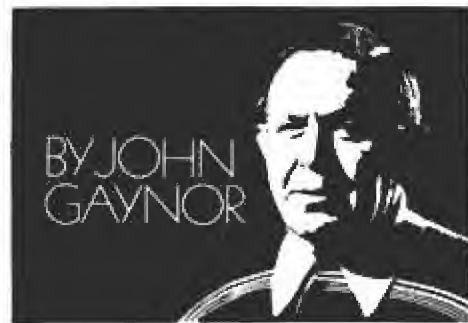
Casement window makers

I am adding a 15 x 20-ft. family room to my Spanish-style home, which was built in 1937. The windows are steel casements and contractors tell me that these are very difficult to obtain. Do you know of any company that manufactures them?

—Ray F. Villegas, Phoenix, Ariz.

There aren't many manufacturers still making them, but one that I contacted said it could make any window to your size and design. For particulars, call or write: A & S Window Associates, 88-19 76th Ave., Glendale, N.Y. 11385, Att. Mr. Lehrbaum. (212) 275-7900.

PM



BY JOHN GAVNOR

A Formby's guide to the buried treasure in your house.

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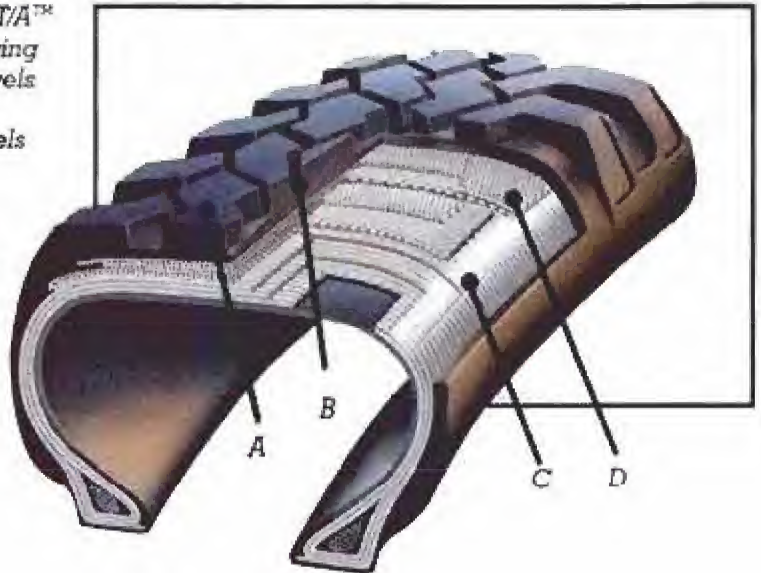


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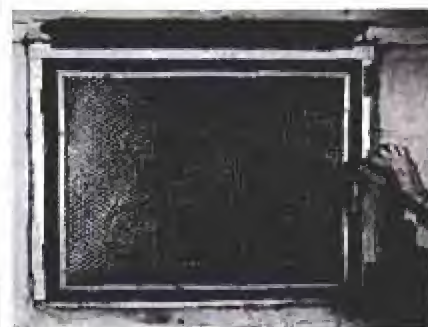
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HINTS FROM READERS

Window blanket



Air pockets in the plastic sheeting give it value as an insulating material.



To secure the sheeting to the window, reader used prebored bamboo strips, held to the jamb with box nails.

Plastic sheeting with air pockets placed over my basement windows insulates them, yet lets light enter. I leave the material on permanently. You can either attach it, as is, with duct tape, or else staple it to a frame.

—John Beilman

Bracing a broom



Diagonal braces prevent a broom handle from breaking at its weak point, where the handle enters the body. The braces shown are 1/4-in.-dia. steel wire bent to shape. Make them different heights to stagger the anchoring screws.

—Walter E. Burton

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What a blow

Stanley now offers Compo-Cast dead-blow hammers that deliver more striking force and reduce head rebounding. The steel rod handles



Compo-Cast hammers come in 22 models (top). All feature metal-shot core (above).

are welded to shot-filled heads, and encased in hot urethane. Prices vary for the 13 soft-faced and 9 steel-faced hammers. A 16-oz. standard head is \$13.60 and a 10-lb. sledge is \$80.19. At hardware stores and home centers, they're made by Stanley Tools, Dept. PID, Box 1800, New Britain, Conn., 06050.—S.W.

Paint and varnish remover

A nonflammable solvent, 5f5, lifts finishes from wood, metal, glass, masonry and fiberglass. Its thick, syruplike consistency prevents runs on vertical surfaces, making it ideal for stripping antique furniture,



Brushed-on coating softens finish fast for removal with wide scraper or steel wool.

moldings and boats. Don't use on plastics, linoleum and rubber tiles. Available at many paint and hardware stores in the Northeast, it's \$13 per gallon. If you live elsewhere, write to the maker for the nearest distributor. Sterling-Clark-Lurton Corp., 184 Commercial St., Malden, Mass. 02148.—S.W.

A booklet and a book

A free booklet, available from Suburban Tool Inc., 2211 Cole St., Birmingham, Mich. 28008, presents that firm's line of semifinished precision tools, including sine plates, vices, magnetic chucks, angle plates and vee blocks. According to the



Catalog explains how to finish-grind precision tools with only a surface grinder.

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—Rosario Capotosto

Super glue solvent

The proliferation of cyanoacrylate glues has brought attention to a growing problem: What can you do

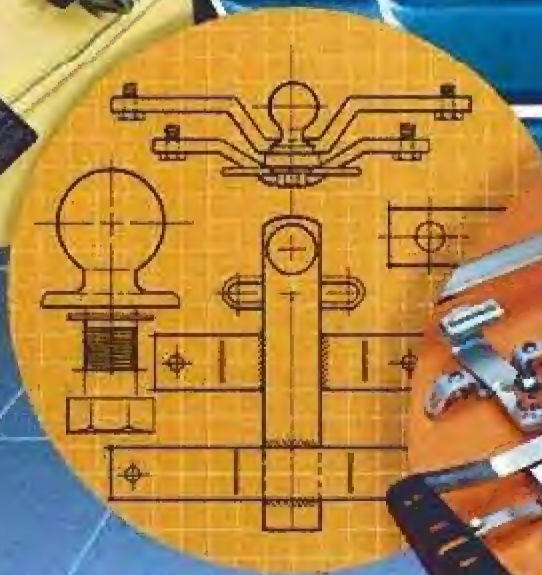


Formulation dissolves super glues. Residue can be removed with soap and water.

when these powerful adhesives are spilled, misapplied or become stuck to fingers? Bando Instant Glue Remover dissolves bonds so that you can reglue items, as well as remove glue from skin, ceramics, plastics, rubber and glass. The product lives up to the manufacturer's claims. It's from Dynatron/Bando Corp., 2160 Hills Ave. N.W., Atlanta, Ga. 30318. A .34-fl.-oz tube is \$1.45 at auto-supply or hardware stores.—H.W.

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

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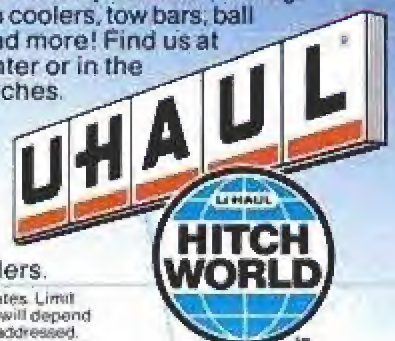
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APPLIANCE CLINIC

QUESTIONS ANSWERED

Burned-out range

On our Whirlpool electric range, model No. RU7764, we've had to replace the bottom bake unit four times in the past eight years. The heating units have lasted from a minimum of one year and five months to a maximum of two years and eight months. When the last one burned out, a serviceman spent an hour and a half checking the range from top to bottom; he couldn't find anything wrong with it. All replacement units that have been installed were factory-specification parts (No. 326793). Can you tell us what the problem may be?

—D. Watkins, Chambersburg, Pa.

Check the terminal ends of the wire going to the heating element. There must be a good, tight connection at this point. If the terminal ends are distorted or burned, replace the wire from the selector switch to the element, as well as the terminal ends, themselves.

If you are using aluminum foil in the oven cavity, be sure not to cover the entire oven bottom with foil. This intensifies the heat reflected back to the bake element and shortens the life of the element.

Confused Mr. Coffee

If possible, I would like to get a wiring diagram to help me reconnect the wires on my Mr. Coffee (Model MC-1AC). I took the wires out to install a new gasket. Now, I don't know where

the red, white or black wires go. Can you help?

—Arthur Itter, South Bend, Ind.

Here's the Mr. Coffee wiring diagram (below). Note that the colored wires go to the switches and the white wires come off the heaters and thermo limiters. This should let you enjoy a fresh pot of coffee soon.

Throbbing refrigerator

I have a Signature frost-free refrigerator with top freezer, model No. HMG-2136-00; serial No. BM-6H61A. I bought the refrigerator new in 1976. For the first four years, it ran very quietly. Recently, the compressor motor started to make a throbbing sound when running. When the compressor starts or stops, it makes a knocking sound. Are the above conditions normal? If not, what can I do to correct the problem?

—Glenn Leamy, Newcomb, N.Y.

Sounds like you have a compressor with internal damage. Montgomery Ward tells us that your refrigerator has a five-year guarantee on the compressor from the date of purchase. The company will replace the compressor free, including labor. Contact your nearest store before the five years are up.

Out-of-sync soap dispenser

My 9-year-old Model KDS-17 Kitchen Aid dishwasher is acting up. I noticed that the door on the automatic soap dispenser either fails to open

or opens late. This leaves the dishes dirty and soapy. I don't want to lubricate the part until I get some advice from an expert. Help!—Philip A. Rotolo, Rochelle Park, N.J.

Possibly the shaft which goes through the body of the soap dispenser has become corroded. This is a stainless-steel shaft; sometimes, surface corrosion builds up on it, which causes the dispenser to be sluggish. We recommend that you replace the entire soap-dispenser assembly, part No. 115-153; the cost is approximately \$12.40.

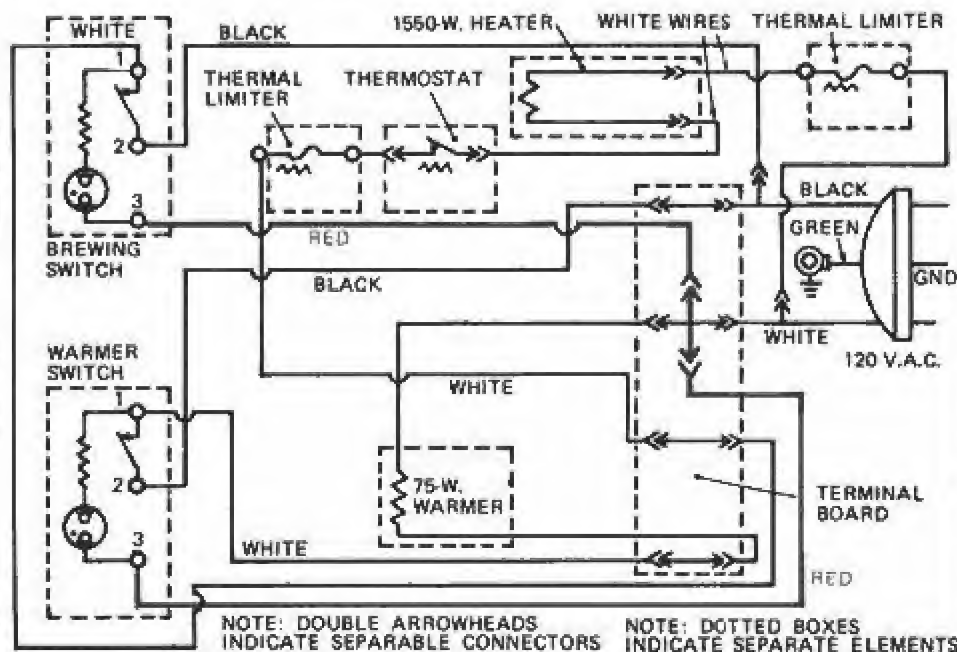
It is fairly easy to replace the soap-dispenser assembly. First, shut off the power to the machine. Then remove the front panel cover, which is held in place by four screws. Disconnect the wires on the dispenser which lead to the inner door panel. Install the new dispenser, using the new gasket supplied in the package.

Controlling water level

I own a Whirlpool automatic washer, Model LAA 3340, which has only one water level—full. Can you tell me how to wash small loads in less water?

—Ray Thompson, Houston.

We checked with Whirlpool to see whether an adjustable water-level switch could be installed in your washer. According to Whirlpool, there is not enough space in the control panel of your washer to install such a switch.



The circuit diagram above shows the wiring for a Mr. Coffee coffeemaker, model MC-1AC.

ENERGY-SAVING TIPS

Following are some energy-saving tips on your refrigerator from General Electric:

- The location of your refrigerator is important. Try not to put it next to your range, near a heating vent or where the sun will shine on it most of the day.
- Refrigerate only those foods that need it.
- Wipe all moisture from bottles and cartons before putting them in the refrigerator.
- Keep all foods covered to reduce moisture buildup in the refrigerator.
- Don't waste ice cubes; take out only as many as you need.
- If you turn the control to the coldest position for quick chilling or freezing, turn it back to the normal setting afterward.
- Don't overcrowd your refrigerator. Overcrowding requires extra electricity to keep everything cool.

If you have a question about any appliance, send it, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.



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10 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method.

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A The Astra Series is a new line of kitchen cabinets made of $\frac{3}{8}$ -in. particleboard covered with plastic laminate inside and out. Four colors are available; white, almond, golden oak and honey pecan (the last two are simulated wood grains). The solid oak door and drawer pulls are integrated into the lines of the cabinet faces. According to the manufacturer, this represents the latest in European styling. For the distributor nearest you, write to the maker: Excel Wood Products Co. Inc., Box 819, Lakewood, N.J. 08701.

B The "Supportable" is a new, 30-lb. folding table that is adaptable to most radial-arm saws, table saws, jointers, shapers and planers. By extending the tables of these machines, one person is able to handle long or wide material that would require two otherwise. The solid oak frame is supported by four 1-in. tubular steel legs. Each one can be adjusted individually to the desired height, from 24

to 48 in. The table is 18 x 60 in., has 10 plastic rollers and costs \$139.95 plus shipping. It comes unassembled from the Turning Point Wood and Metal Works, Box 107, Davenport, N.D. 58021.

C Sharp 'n Sand is a new, upright, drill-powered belt sander that costs \$25 and uses 3 x 24-in. sanding belts. The price includes a belt and a drill support bracket that fits most $\frac{1}{4}$ -, $\frac{3}{8}$ - and $\frac{1}{2}$ -in. drills. Both the bracket and sander can be bolted to a workbench or an optional base (\$7). It has adjustable work supports and a vacuum-cleaner hose adapter. At hardware stores and home centers, it's from Black & Decker Inc., 701 East Joppa Rd., Towson, Md. 21204.

D The Director is a new, UL-approved kerosene heater that can rotate 30° to the left or right. It comes with a flame-control knob, visible fuel gauge, a drip tray to protect carpets and floors, and a battery-powered ignition coil. An automatic shutoff extinguishes the flame if the heater is bumped. Also offered is a catalytic element (\$30) that cuts chance of odor at startup and shutdown. It's 35 lbs., puts out 11,000 B.T.U.s per hour and costs \$269.95 at home centers and hardware stores. From Kero-Sun Inc., Kent, Conn. 06757.



C



D





THE VANAGON. NOW CAN WE TALK YOU INTO IT?

If it's been some time since you were in a Volkswagen Bus, maybe you should spend some time in a new Volkswagen Vanagon.

You'll hardly recognize the place.

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It can carry a whopping 40% more luggage than it used to.

The interior is Very Civilized. Large, comfortable seats. Flow-thru ventilation.

And wait till you see what you can see out the big, new windows. The rear window alone is 50% larger.

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Which makes for better stability.

And which brings us to the biggest surprise about the new Vanagon:

The ride.

You won't believe how good it is. You'll feel like you're driving a sedan. All thanks to the following:

A more powerful engine. A wider track. A new suspension system. A new steering system. A new brake system.

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Just try talking yourself out of one.

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AGAIN**



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It comes to grips with almost any condition.



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Its tread and construction give you the traction characteristics of a mud-snow tire.

The fact is, Goodyear Wrangler Radials were developed and proved in off-road racing. Through deep mud, over sharp rocks, across deep sand.

And, unlike some tires of its type, Wrangler Radial has a tread computer-

ALL-POSITION WRANGLER RADIAL.



designed for quiet highway driving.

Wrangler Radial also has steel-belted construction. With the greater strength, flatter footprint, longer tread life, and slightly better fuel economy that radials offer over bias-ply tires.

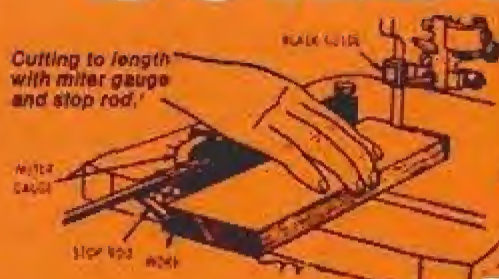
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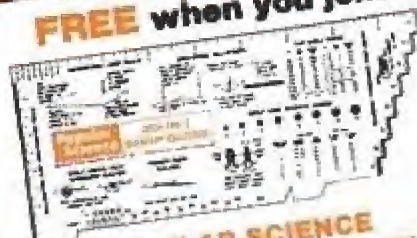
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This information-packed 4-VOLUME CARPENTERS AND BUILDERS LIBRARY brings you professional, easy-to-understand how-to on just about every build-it-yourself question you'll ever have...

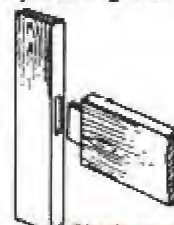
- You get a complete how-to book on woods and woodworking tools, how to do all kinds of joinery and cabinetmaking joints, how to do kitchen cabinet construction... *and more.*
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- You get a complete how-to book on laying out the foundation, how to do concrete block construction, house framing, chimneys, fireplaces, porches, patios, insulation... *and more.*
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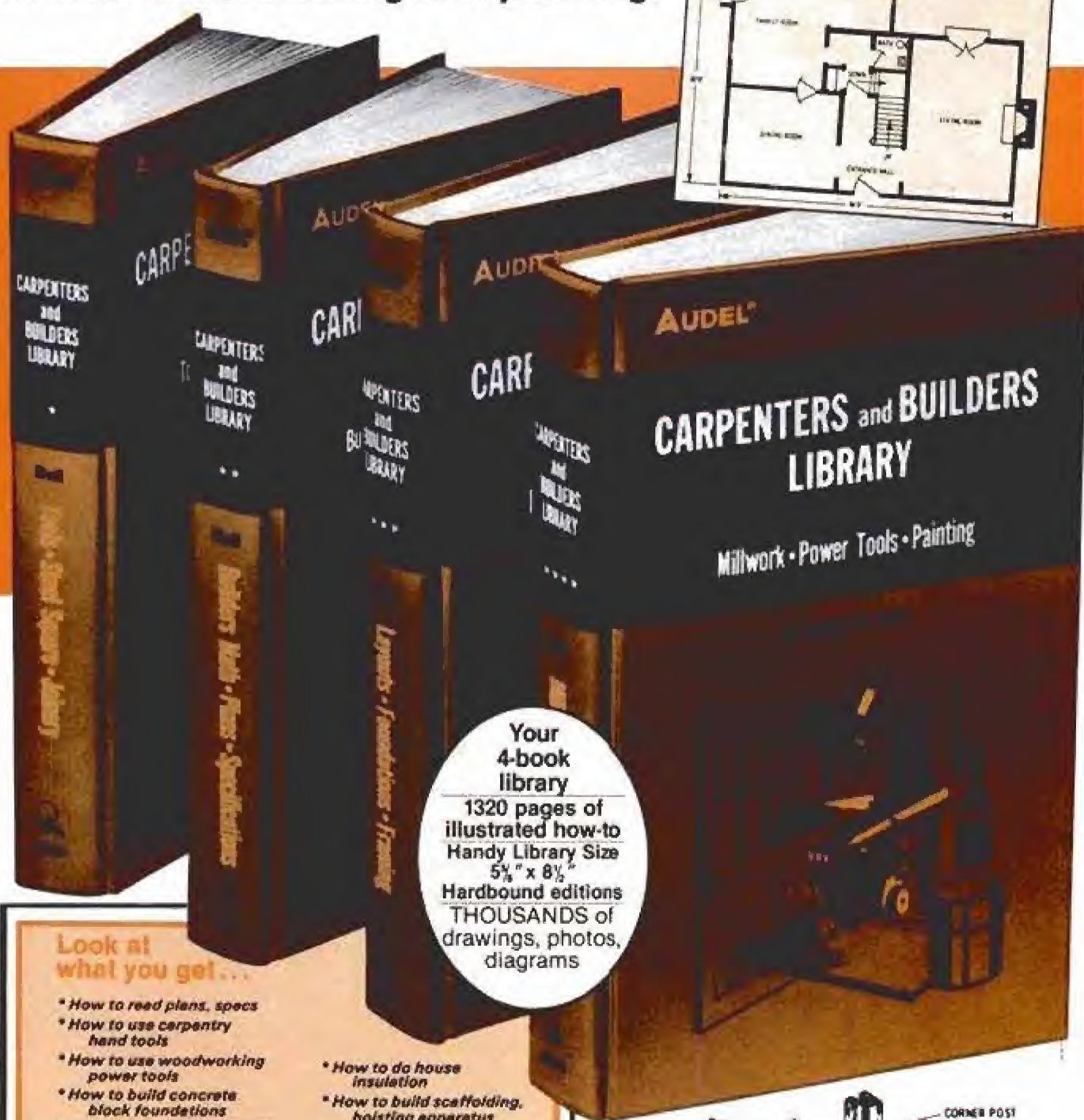
These books teach you scores of tricks and shortcuts used by carpenters for measuring, cutting, raising, fastening, finishing—every technique and job. They give you the answers to just about every carpentry question you'll ever have. And they can save you thousands of dollars in the years ahead.



Single mortise and tenon joint.

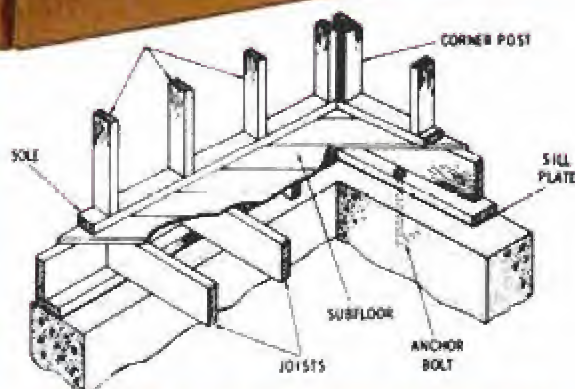
Installing metal shingles under wood shingles.

**you need to know to do just about
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- * How to plan termite protection
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over *ten thousand* products a year. At the Chicago lab you might see machines slamming weights onto seats of children's swings to learn which of a variety of plastics is strongest. You might see dozens of new fabrics undergoing tests for color fastness, shrinkage, and flame resistance.

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Thanks in large part to the work of Sears laboratories, many millions of people have been satisfied shopping at Sears.

Sears

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◀ A Sears technician checks the effects of Florida sun and humidity on samples of potential Sears paints. There are some 20,000 panels, each with up to four paint samples, many under test for five years.

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Fall care for a great lawn next spring



If your lawn is dense, but has become overrun with weeds, treat it now with a combination fertilizer and broadleaf weed control.

The homeowner whose lawn looks sparse and weedy at summer's end can do more for it now than by waiting until spring. First he must answer a key question: Should I *weed*—get rid of dandelions and other broadleaf weeds—or should I *seed*—add new grass—to my lawn?

You can't *weed and seed* in fall, say researchers at O.M. Scott & Sons. The reason is that a broadleaf weed control can harm tender new grass plants, unless they have been growing long enough to be cut four times. By the time plants mature to this stage, it's too late in the season for weed control to be effective.

Here are some questions a lawn owner can ask to help choose between weeding and seeding:

■ Are there lots of bare spots and just a few weeds? Then put down grass seed. Also use a fertilizer high in phosphorus (the second number of the three listed on the bag) to pro-

mote early plant growth. Wait until spring to go after weeds.

■ Is the lawn full of weeds, with few bare spots? Then eliminate weeds now and wait until spring to seed. Use a combination weed control and fertilizer product that controls dandelion, plantain, chickweed, white clover and other broadleaf weeds. As weeds die, fertilizer strengthens grass plants and helps them fill in spots vacated by weeds.

■ Does the lawn have crabgrass and bare spots, but no broadleaf weeds? Crabgrass is different from broadleaf weeds. It's an annual that's coming to the end of its life now. New plants grow from seed. Now you should seed and fertilize. Next spring, use fertilizer/crabgrass preventer before crabgrass comes.

Whether you put down seed or weed control, you should fertilize your lawn. Fertilizer benefits a lawn most in the fall. **PM**



1. Prepare a thin lawn for fall seeding by loosening or slicing the soil to a ¼- to ½-in. depth. Seed bed should be firm, but not packed. 2. Spread seed liberally with a spreader or by hand and work it lightly into

the top ¼ in. of soil. 3. Continuous presence of moisture is essential for the seeds to germinate. Keep the soil moist, but not flooded, by using a sprinkler with a gentle spray for the most favorable results.



'Waiter, what's that silicon chip doing in my soup?'

Not long from now, you may find it impossible to change your mind about a restaurant dinner order once you've given it to the waiter. That's the major negative feature of a system being explored by Siemens, A.G., the West German electronic data firm. Using an apparatus sensitive to infrared signals, like a TV channel-changer, the system would transmit orders directly from tableside to kitchen via the waiter's handset aimed roughly at a receiving point. Food preparation would begin immediately upon receipt of the coded digital order, and the waiter, in turn, could be updated as to the dishes no longer available. The computer system can also transmit a separate bar order and will, naturally, print out an immediate bill.

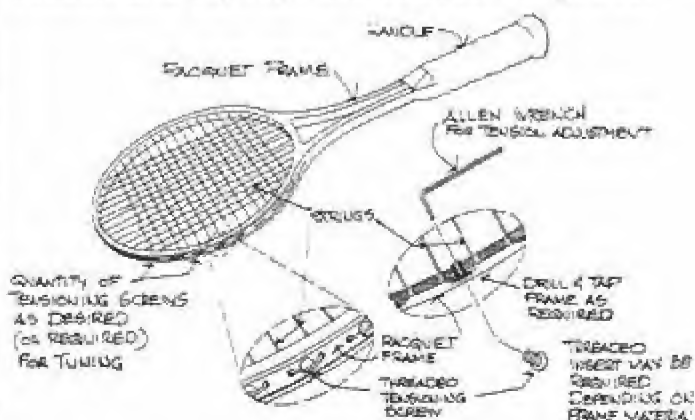
At this point, however, nobody's sure how code numbers will affect the appeal of a menu written in French.

Hey, Pancho, gimme a G...

Watch tennis players at any level of proficiency. What's the first thing they do after a blown shot? (A) Stare at the center of the racquet. (B) Hammer the racquet strings with the heel of the opposite hand. Once these basic maneuvers are mastered, any bad ball can be laid off on the equipment—primarily, the strings.

Dallas tennis pro Craig Wilson wants to spoil all that. He has a patent for a simple system that uses an Allen wrench to torque threaded inserts in a racquet frame, making it possible to tune your racquet like a guitar, if you want to. Such a system, Wilson claims, would not only give tournament-level players a precision feel on any given day, but would also add longevity to the synthetic strings used by most recreational players.

But without a ready mechanical excuse for atrociously flubbed volleys, PM predicts that players themselves will become unstrung long before their racquets give out.



Vintage emissions

American buyers of the Renault 18i have had some nice things to say about the car (see *Owners Report* in this issue, page 172), but at least one out of 10 has yearned for a little more under the hood. That probably would not be the case in France, where PM got to do some B.C.—Before Controls—driving in an 18i made for the home market. Without the U.S. emissions system, the car has as much as 20 percent more power going for it, depending on rpm range, and is quite a jaunty little sedan.

The French drive their turnpike-style Autoroutes according to displacement, with the nominal 130-km/hour (81 mph) speed limit universally ignored. This means the left lane is preempted by sports equipment and the big Mercedes and Citroen sedans. The 18i's proper place is no doubt the middle lane, but we got out with the big guys and stayed for a while, pushed to 150 km/hour (93 mph) in the traffic stream for one stretch. The car felt right at home, perhaps a touch noisy, but not at all squirrely on its underpinnings, and gave a comfortable ride on highways that are not nearly so smoothly finished as U.S. Interstates (but somehow stay in one piece over the years).

Not surprisingly, on the off-Autoroute roads that wind through the scenic Burgundy vineyard country, the R-18i also felt like it lived there. The brakes gave an excellent account of themselves in one near-incident, when the driver forgot that in France, anything

approaching from your right, at any speed—even in traffic circles—has an apparently God-given right of way.

Then, a few miles south of Paris on the Autoroute, our return was halted by a massive tie-up. We sat for a full half-hour, inhaling straight-pipe automotive emissions that left you with a cheese aftertaste and a wine hangover. Not everyone agrees that the official U.S. solution to that problem is the only one, or even the best, but it's obvious that Europeans are paying a certain price for the privilege of B.C. driving.



A pause south of Paris in the Renault 18i (right) whilst we taste the fumes of the countryside and get zero kilometers per gallon.



Converted barge is a family home moored in a steep section of canal locks near the Yonne River in Burgundy, in eastern France.



When a few hundred tons of barge gets moving, it takes a while to stop. Maneuvers with the typical small diesel engines are exacting, while mistakes are potentially spectacular.



Tourist-style barge with bikes and cafe umbrellas on deck; cruises cover historical cities, vineyard areas and lush scenery.



Sometimes automobiles go along...



...sometimes they don't.

Slow boats

In northern Europe, the owner/skipper of a working river barge is the romantic equivalent of the gypsy trucker in the United States. But, in the case of the bargeman, the romance is generally flavored with domesticity because, in his endless prowling of the waterways of Europe in search of bulk cargo of one kind or other, he takes his entire family with him. Near Sens, France, we recently watched father, mother and daughter (no more than 12 years old) easily winch a small car off the deck of their floating home and lower it 10 feet to the quayside from a *hand-operated* crane—and off they drove to shop in town.

Strictly leisure-oriented conversions of working river barges have caught on in recent years; a company based in Dublin, Ireland, called Floating Through Europe Inc., books its barges just like cruise ships. Smaller barges are even being purchased as vacation homes (at about \$10,000 plus conversion costs) by adventurous families who roam as far as Poland and Russia while touring the waterway system. Strings of barges are towed across the English Channel, in calm weather, where a company specializing in cruising conversions makes them comfortable, if not stylish.

With several hundred tons of barge and an engine rated at as little as 30 hp, speed is not of the essence. Some fast-flowing rivers are strictly out of bounds, and even on the quiet ones, piloting proficiency is essential. Other tricks, like partly flooding the cargo holds and sinking almost to deck level in your winter port to take advantage of the insulating qualities of water, are picked up from seasoned barge-dwellers along the way. But it's hard to beat for a low-energy, vagabond lifestyle. One British artist we met demonstrated his commitment by entombing his VW Beetle on the riverbank, his landlubber days put forever behind him.

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David Fairbrother—Dave's Locksmith Service Milwaukee, Wisconsin 53209



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Lever-action wrench lets you work in tight spaces. It has reversible action.

end of the shank. You can operate the lever, to loosen or tighten. You'll find this tool a big help for some water pumps, among other jobs. Called Crick-It, the tool lists for \$23.

To locate your nearest dealer, write to Davenport Tool Co., 102 North Washington St., Rochelle, Ill. 61068.—Paul Weissler

Oil-filter relief

Getting to the 3-in.-diameter oil filters on some of the new small cars isn't very easy. Conventional oil-filter wrenches don't fit in such confined spaces. The Lisle Corp. has come to the rescue once again with a coiled-steel, springlike device designed to slip over filter housings. It has a hex nut fixed to the base of the tool. Use your 3/4-in. open-end or socket wrench and twist off the oil filter.



Oil-filter wrench has hex fitting at the bottom for use with a ratchet wrench.

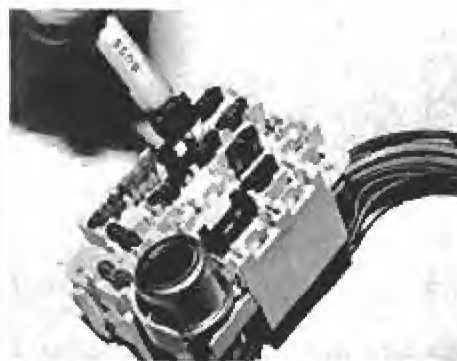
This tool costs \$8 at most auto parts stores. Lisle Corp.'s address is 807 Main St., Clarinda, Iowa 51632.

—Joel Breault

Spade-fuse puller

Virtually all late-model cars have the spade-type fuses, and the only way you can inspect them is to pull them out. You can dig them out with your nails, but there's an easier way: a puller introduced by the manufacturer of Buss fuses.

You just push the tool down on the fuse and its spring-clip end goes over and locks onto the fuse. To install, just push the fuse into place, then twist the tool slightly to release it. Price is \$2.43 list, from Bussman



New fuse puller is specially made for the spade-type fuses currently in use.

Div., McGraw-Edison Co., Box 14460, St. Louis, Mo. 63178.

—Paul Weissler

Worklight

Finally, someone has come up with a 12-volt worklight that's really usable, and for less than \$15.

First, it connects to the car battery. Next, it has a 16-ft. cord, so you



Worklight has 16 feet of cord to light up even the remotest areas of your car.

can reach almost anywhere, and even get close enough to light up the back for a tire change or wiring up a dangling muffler.

The cord winds into a small spool, so it doesn't get twisted and broken. The lamp body has both an alligator clip and a rubberlike magnet, so you can attach it almost anywhere. The bulb is a standard taillight number.

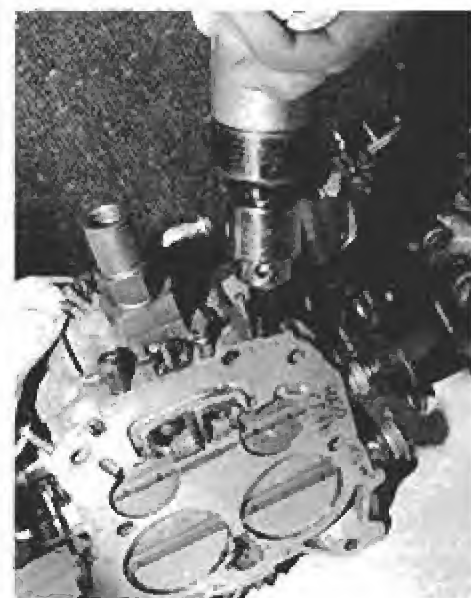
The worklight is made by Thexton Manufacturing Co., Box 35008, Minneapolis, Minn. 55435 (no mail orders).—Paul Weissler

GM idle-mixture kit

Is the mixture too lean on your late-model GM car with plugged needles? There's a new \$13 kit for safe removal and adjustment.

The kit also includes parts to keep the hole saw aligned with the plug, a spring-loaded centering pin that goes into the saw and rests against the plug (1980-and-later cars) and a drill guide for earlier cars.

As you drill, you must spray water to cool the drill. Once you cut through (the saw has a stop), you take out the plug and use the kit's mixture adjusting tool, which has a different slot on each end for the two



Carb kit is made to gain access to the sealed adjustments on new carburetors.

types of mixture needle heads in use. On a few cars, you can do the job on the car; on most you must pull the carb. The kit is by Thexton Mfg. Co., Box 35008, Minneapolis, Minn. 55435. It's at auto parts stores (no mail orders).—Paul Weissler

A comparison of projections from manufacturers' treadwear ratings under the new government Uniform Tire Quality Grading System indicates that on a government-specified course:

Michelin fell a little short of the Uniroyal Steeler. About 24,000 miles short.

For many people, Michelin has always been the yardstick to compare other tires by.

But recently, the U.S. Department of Transportation gave the public a standardized system. Now, each tire company is required by law to grade its tires in three areas. Traction. Temperature resistance. And treadwear.

And then to emboss the resulting grades on the sides of the tires.

When compared, Michelin's XWW fared somewhat better than Uniroyal's comparable Steeler in the traction and temperature resistance tests.

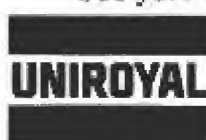
But when it came to the important grade that indicates the relative wear rate of your tire, Michelin's tire fell a little short. In fact, when you translate their ratings into projected miles on the government-specified test course, you see it was no photo finish.

On that course, the mileage projection for Uniroyal's Steeler is 66,000 miles. 24,000 miles longer than Michelin's rating projects.

(And, by the way, 15,000 miles longer than the projections from the ratings of the Goodyear, Goodrich, General and most Firestone tires in the chart.)

These mileage projections (including those in the chart) should be used for comparison only. You will probably not achieve these results. Actual treadlife will vary substantially due to your driving habits, condition of vehicle and, in many sections of the country, road conditions and climate.

See your Uniroyal dealer for details.



You'll see there may be a new yardstick to compare tires by.
Uniroyal.

Clip and take this to your Uniroyal dealer.

MANUFACTURERS' RATINGS FOR U.S. GOVERNMENT QUALITY GRADING SYSTEM			PROJECTION OF MILEAGE ON GOVERNMENT- SPECIFIED TEST COURSE
Manufacturer/Tire:	Traction and Temperature Resistance	Treadwear	
UNIROYAL Steeler	B/C	220	66,000
GOODYEAR Custom Polysteel	B/C	170	51,000
FIRESTONE 721 (13" & 14" sizes)	B/C	170*	51,000
GENERAL Dual Steel II	B/C	170	51,000
B.F. GOODRICH Life Saver XLM	B/C	170	51,000
MICHELIN XWW	A/B	140	42,000

* Most 15" Firestone 721 tires rated 200 which projects to 60,000 miles.

Source: U.S. D.O.T. 12/19/80.

For a free booklet on grade-labeling, please send your name and address to:
Uniroyal, Inc., Tire Advertising Department, Middlebury, Connecticut 06749.
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**When you compare,
you want Uniroyal there.**

PM ELECTRONICS MONITOR

What a relief

The GM J-cars that are rolling off the lines are sporting sleek, new J-car radios. These newly designed, in-dash units are styled differently from what you might expect in a car radio.

The front panels are almost twice as high as those on a conventionally designed radio. The cassette deck, for instance, has its own slot for the tape; the radio tuning dial positioned above it does not fold in, as on compact designs.

News of this radio's front-panel dimensions (especially its height of 4 inches) leaked out beforehand and caused much consternation in the auto-sound companies. The people whose livelihood depended on selling radios that would fit GM cars were less than happy to hear that GM had radically changed the shape of its mainstay radio.

Dealers with large inventories of sound equipment on their shelves and in their storerooms were also heard to mumble uncomplimentary things about GM trying to cut out the aftermarket. For a while, it looked as if a real battle was a-brewing.

But the new J-radios turned out to be no deeper than their older, conventional counterparts. This means that most aftermarket car radios will indeed fit a J-car dash. The only trouble is that a skinny radio (the height of the front panel is about 2 inches) would tend to wobble in a J-car's dashboard. Never fear—already, one manufacturer of bezels and other installation aids (Metra Electronics) is selling special brackets so you can perform your own J-car installations.

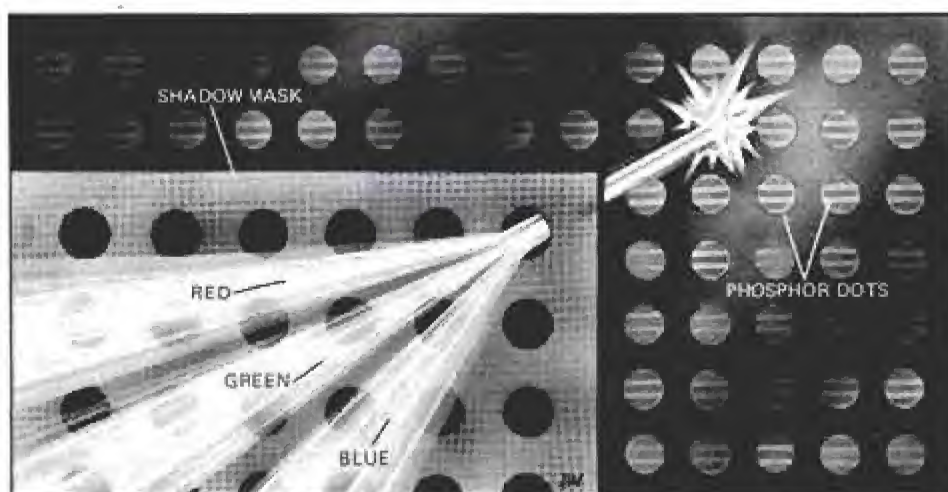
Not that we suspect GM of anything, but we can't help wondering what odd dimensions the next model J-radio will have.

Clearly better

We saw the new Matsushita (Panasonic) high-definition satellite TV system at the Chicago Consumer Electronics Show. It was the most dazzling television picture we had ever seen—as breathtaking as a well-developed 35-mm slide.

The TV system is a superhigh-frequency broadcasting and receiving setup. The idea is to send satellite TV directly to the home via a rooftop dish—and to make TV signals on this system even better than those transmitted by cable.

Well, they have succeeded—at



On-screen palette

For those of you who've ever wondered how your color TV produces a rainbow of hues, here's a simplified explanation. The inside of the screen is coated with three pigments of phosphor—red, green and blue. The three colors cluster together in pinpoint-sized dots or

stripes. They are lighted by three electron beams focused through a shadowmask; the beams paint the picture. With just three phosphor colors, your screen mixes every other color—much like an electronic artist stirring a palette of paints.

least in picture quality. A normal TV has about 12 megahertz (MHz) of video bandwidth; this new system features 30 MHz of width. The result is greater clarity of color, better brightness and an all-around livelier picture. And as far as resolution—would you believe 1125 scan lines? The detail on the screen has never been approached before on a TV set.

There's only one problem—this system is incompatible with existing TV standards. The question comes to mind: If this system of satellite broadcast takes hold, would a viewer need two TVs—one to watch high-resolution satellite TV, and the other for cable and regular broadcast?

But no matter how—or even if—this system is finally implemented, it was an exciting experience to see how realistic and beautiful a TV picture could be.

Here and there

Walking the aisles of the Chicago Consumer Electronics Show also revealed new devices in every field of electronics.

Chess computers are now the rage. Mattel is entering the fray with a beautiful liquid-crystal display. A company called Scientific Systems showed an impressive lineup of new chess computers. And Fidelity was there with a new line of Chess Challengers that look as formidable as ever. Hopefully, we can schedule another Tournament of the Chips soon.

If you're a scanner hobbyist, you will love the new BMP 10/60 set from Fox. The unit can be used in the home or it can be attached to a battery pack and taken out into the field. With 60 preprogrammed channels that were especially selected for nationwide activity, it looks like a good buy for \$350.

One of the stars of the show (which we will be reviewing soon in depth) was Commodore's VIC 20 computer. It has color, sound and TV compatibility, along with easy programming, for the astonishing price of \$300. The unit is similar to the Commodore PET computer in that it can use much of the same software. But its capabilities far exceed the PET's as far as color and sound. Peripherals, such as disc drives and a printer, are in the planning stage.

If this little computer generates some software support—and we think it will—it should have great appeal for first-time buyers. It may very well end up as your first computer.



A CUT ABOVE THE REST

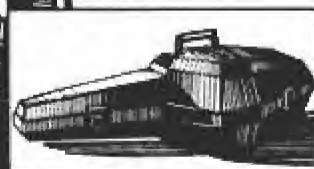
OUTDOOR TOOLS ON SALE AT K MART

On Sale September 14 through September 26



\$167⁸⁸

Homelite VI
Super 2 16-Inch
Chain Saw
w/Carrying
Case



Timber! That's the sound of falling wintertime fuel bills, a sound you'll hear when you cut your own firewood with quality sale-priced outdoor tools at K mart.

The traditional woodsman will recognize the quality of the True Temper Single Bit Axe, with its solid hickory handle and forged steel head. He'll like the way the 3-pound Splitting Wedge and the Stanley 8-pound Sledge complement each other in reducing big logs to a more manageable size. And if he's the economical type he'll be intrigued by the potential of the 6-pound Splitting Maul, a combination sledgehammer and axe.

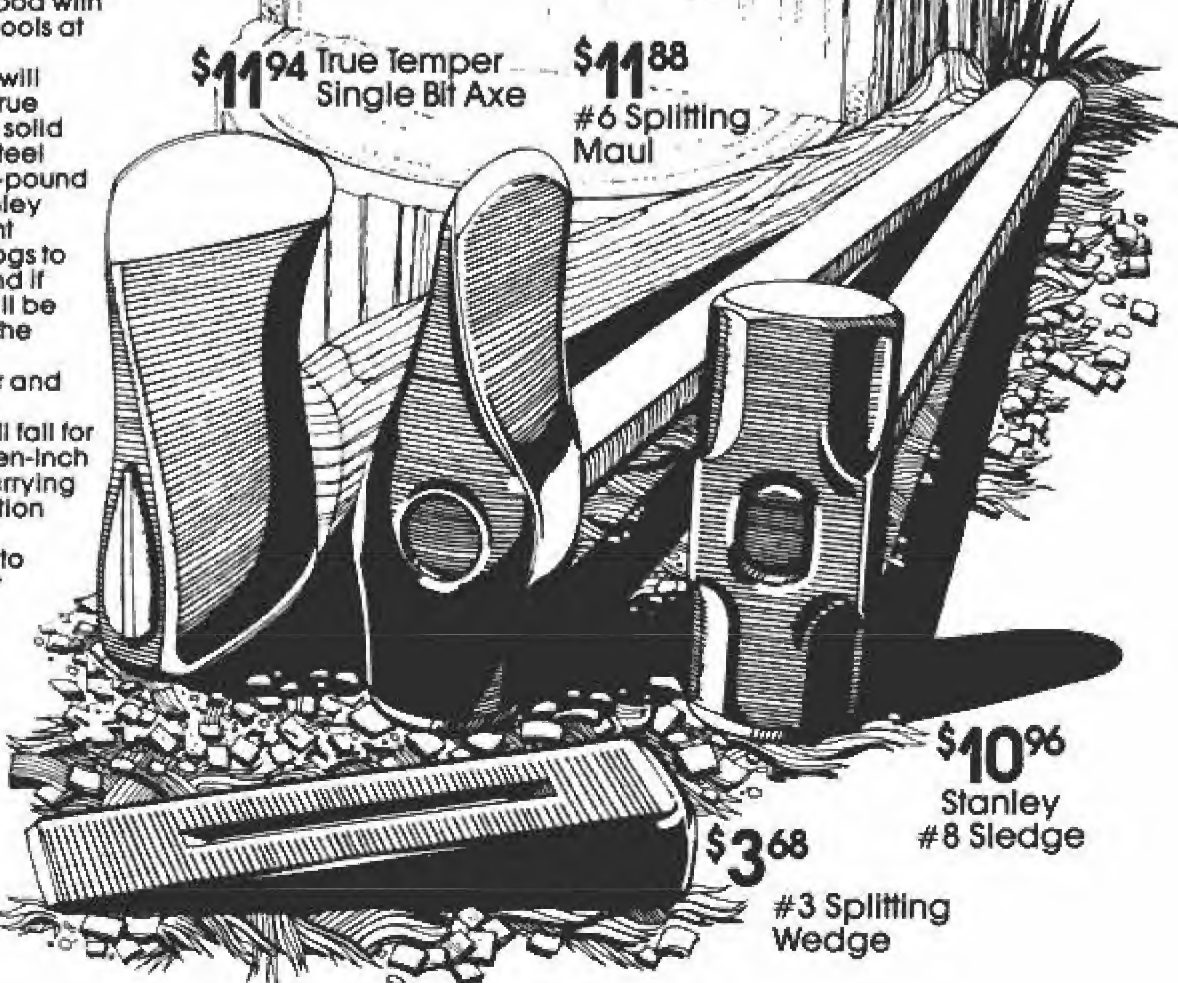
The modern woodsman will fall for the Homelite VI Super 2 Sixteen-Inch Chain Saw complete with carrying case. Its VI (three-point Vibration Isolation) system reduces vibrations, enabling the user to maintain complete control. It features automatic oiling, a safety throttle interlock control system, and Homelite's exclusive SAFE-T-TIP to prevent kickback and to protect the saw tip. And it's big enough to handle any job!

Whether you're a modern or a traditional woodsman, you can start cutting wintertime fuel bills today with quality outdoor tools on sale at over 1,800 K mart stores across the U.S.A.

\$11⁹⁴ True Temper
Single Bit Axe

\$11⁸⁸

#6 Splitting
Maul



\$10⁹⁶

Stanley
#8 Sledge

\$3⁶⁸

#3 Splitting
Wedge

Quality at a K mart price. Nice.

Kmart
The Saving Place SM

CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES BY MORT SCHULTZ



Civic disturbance

I'm confused. When I was shopping for a small car I could tow behind my motor home, the salesman at the Honda agency assured me the Civic with manual transmission would fill the bill. I bought the car, but the owner's manual states emphatically not to tow the front-wheel-drive Civic with its front wheels on the ground, except for short distances at slow speeds. The salesman and owner of the agency say to disregard these instructions. I don't know what to do. Please help.—Milton Weiss, Augusta, Ga.

A spokesman for the technical services department at American Honda Motor Co. says not to tow your Civic for long distances with front wheels on the ground. Doing so will put a strain on the manual transaxle (transmission and differential assembly), which could cause damage.

There are several companies that make rigid V-shaped tow bars for towing the Honda Civic and other front-wheel-drive cars. You can get information about them by scanning ads in recreational-vehicle magazines. RV dealers can also offer advice. These tow bars keep the front wheels raised, so the car rolls on the rear wheels. There are no components in the rear which can be damaged. This is the only way you should tow the Civic and other front-wheel-drive cars.

Quell gel

I fear the coming winter because of my 1980 Chevrolet diesel-engine pickup truck. In subzero conditions (-10°F . or lower), the engine starts, runs three miles and stalls. I then have to get it towed to a warm garage, where it sits for a few hours before it will start again.

The Chevy dealer can't find anything wrong with the engine; I faithfully use the specified fuels and built-in block heater; and I've been assured by the fuel dealer that the fuel he's selling me is the required grade for cold weather.

Everyone agrees that low tempera-

ture is causing fuel to gel in the fuel line—that this gel is plugging the fuel filter and cutting off fuel to the engine. But no one can tell me what to do about it.

I thought I had the problem licked when I read in PM that 1981 GM diesel-engine vehicles are being equipped with fuel-line heaters to warm fuel and prevent gelling. I asked a GM zone representative if I could have this heater installed in my truck. He said no—that heaters are not being supplied for older GM vehicles.

What other course of action can I take, other than putting this new truck on blocks for the winter?—Michael S. Pander, Mansfield Center, Conn.

The GM rep is *wrong*. According to a spokesman at the GM Service Research Center in Warren, Mich., the fuel-line heater is available for pre-1981 diesel-equipped GM pickups and passenger cars which are experiencing fuel gelling in cold weather.

The part number to use in ordering the heater for your truck is 22511639. The part number for the passenger-car heater is 22511638. Both heaters are the same. Only the routing of the electrical feed wire differs.

Diesel fuel 101

I recently purchased a used 1977 Volkswagen Rabbit diesel. It's the first diesel I've ever owned. Since the owner's manual is missing, I don't have information about what to feed my Rabbit, and I can use a short, understandable course in diesel fuel technology. Is this request general and interesting enough to warrant a response in your column?—Albert Dutcher, St. Paul, Minn.

Yes it is, especially since I've received requests for the same information from many other readers. So here's your short course. Are you listening, class?

Diesel fuel is commonly available in two grades: No. 1 and No. 2. No. 1 grade is generally regarded as winter fuel and No. 2 grade as summer fuel, because at about 20°F . No. 2 diesel fuel begins forming wax crystals (or gel). No. 1 diesel fuel, which has a lower viscosity, doesn't. Wax (or gel) can clog the fuel filter and stop the engine dead in its tracks (see Mr. Pander's problem, left).

However, using No. 1 in winter and No. 2 in summer isn't as simple as it sounds. For example, Volkswagen recommends that you not use No. 1 diesel fuel in your '77 Rabbit—that you use No. 2 diesel fuel all the time. No. 2 diesel fuel has certain lubricating qualities not possessed by No. 1 grade. This lubrication is needed to keep the fuel-injection pump working. The pump has no source of lubrication other than the diesel fuel. Forced to run on No. 1 grade fuel, it may be damaged.

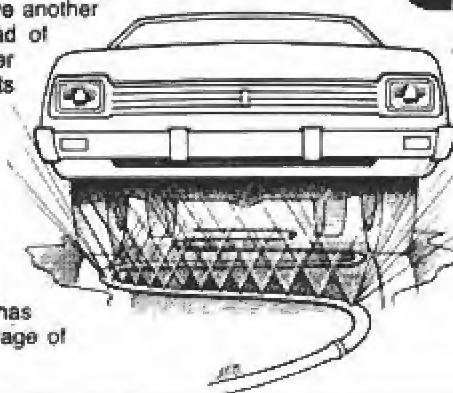
So what do you do when the temperature falls below 20°F ? You use a *winterized* No. 2 grade fuel, which has additives that help forestall waxing down to about -10°F . Any fuel dealer should be willing to tell you whether his fuel tanks contain

(Please turn to page 50)

Refreshing shower

While a lawn soaker hose is good for the greenery around your house, it also can serve another purpose—to help retard the spread of auto-body rust. Mile after mile, winter and summer, underside body parts are subjected to road salts, oil, sand and dirt that can begin to eat at metal.

In order to help reduce the accumulation, lay out the soaker hose, turn on water and drive your car back and forth over the hose a few times. Water shooting upward will rinse away much of the junk that has been building up on the undercarriage of your car.



PM CAR CARE
TIP

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If you own a home which is suitable for the application of siding, you just apply one of our Home Kits to your home.

What is a Home Kit?

A Home Kit is a complete kit of aluminum, steel or vinyl siding for covering a frame home. It includes all siding panels, window trim, door trim and pre-formed corner mouldings—even all the tools and nails you need. Kits are available in 22 colors and 14 different sizes.

How hard is it to do the job?

Not hard at all. With our super-easy-to-follow instructions, if you can drive a nail and cut on a straight line you can't miss.

How much will I really save?

You'll be buying your home kit for about 1/3 below the national average of applied siding costs (about \$2,000.00 less). And your kit also includes all tools and accessories.

Can I buy my first Home Kit on time?

Of course. As a matter of fact, most of our dealers buy their first Home Kit on either an FHA Home Improvement Loan Plan, or our own interest-free, carrying charge-free, \$7.00 a week plan.

Exactly what do I have to do to become a dealer?

All you have to do is apply one of our Home Kits to your own home. There are no other fees, charges or requirements. And once your friends and neighbors see how beautiful your home looks and find out

you did it yourself . . . you'll have customers waiting in line. Especially when they find out how much you can save them and that they'll never have to paint again.

How much money can I make?

You can make up to \$1,000.00 per order, even more if you apply kits for your customers. You can work part-time or full-time. (Most of our dealers work part-time, using their Home Kit sales to supplement their regular income.)

How do I get started?

If your home is suitable for the application of siding, just mail this coupon, or call us toll-free at 1-800-643-9904. If we have an opening in your county for a part-time or full-time dealer, we'll contact you.

That's all there is to it. Remember, there are absolutely no charges or fees for a dealership. All you have to do is purchase and install your first Home Kit.

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J.E.—Alabama

"My wife helped me apply the siding and found it easy to do."

O.S.—New York

"A neighbor inspected my home (after application of a vinyl Home-Kit) and she was so pleased with the results that she immediately ordered a Home-Kit for her house . . . I want to thank Aluminum Industries for saving me a lot of money and for their great assistance in helping me launch a new business."

F.L.—Connecticut

"Thanks to your fine service I have nothing but satisfied and happy customers. Your ability and accuracy in anticipating the accessories needed with each Kit never fails to amaze me . . . keep up the good work."

C.M.—California

"Easy to apply. I had a bid from a local siding company that was over \$2,000 higher than the cost of your Home-Kit."

A.H.—Tennessee

The original letters from which these comments are taken are on file and available for inspection at Aluminum Industries Home Office.

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or call toll-free
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Aluminum Industries Of Arkansas

Dept. PM-91, 300 Phillips Road, North Little Rock, AR 72117

Sounds interesting, please send more information.

Name _____

Address _____

City _____

State _____

Zip _____

CAR CLINIC

(Continued from page 48)

No. 1, No. 2 or the winterized No. 2 version.

The inevitable question is: What do you do if you have to use winterized No. 2 and the temperature falls below -10°F ., turning fuel waxy? Many Rabbit owners I know add kerosene to winterized No. 2 diesel fuel in a proportion of about 80 percent No. 2 to 20 percent kerosene. They have experienced good results; that is, no waxing and no fuel-injection-pump failure.

A final lesson in this short course has to do with the term "cetane rating." It is to diesel fuel what octane rating is to gasoline.

Diesel fuel is refined to give fast spontaneous combustion. Gasoline, on the other hand, is refined to resist fast spontaneous combustion. If gasoline burns too quickly, the engine will detonate and ping. The pinging noise is caused by the vibration of engine parts during detonation.

The rate of diesel fuel combustion is measured in terms of cetane numbers. Cetane is a fast-burning laboratory test fuel which is used as a standard for making comparisons between it and diesel fuel blends. A

diesel fuel having a cetane rating of 100 means the diesel fuel burns very quickly.

Cetane rating is the reverse of octane rating. An octane rating of 100 signifies a very slow-burning gasoline. The lower gasoline is rated on the octane scale (95, 92, 89, 87 and so forth), the faster it burns.

VW recommends that you feed your '77 Rabbit No. 2 diesel fuel (winterized No. 2 in cold weather) having a cetane rating of 45. Class dismissed.

No refund

This is regarding the item in your service tips of the January 1981 Car

Clinic (page 50) referring to the warranty extension by Chrysler Corp. You say Chrysler will pay for parts and labor to correct problems with 1978-80 Omni and Horizon front-wheel bearings, automatic transaxles, distributors and oil pumps up to 24 months or 24,000 miles following purchase of the car new. This is a doubling of the time expressed in the written warranty.

Before reading this tip, I had to have the Hall distributor sensor and rotor replaced in my 1980 Omni at 12,400 miles, and I paid the dealer for the job.

After reading the tip, I called the dealer (and four other dealers to seek

Walking and squawking

A clicking or grinding noise coming from the wheels, especially when the car is making turns, could signal a defective wheel bearing. However, before you go to the trouble of pulling wheels to get at the bearings, remove all four wheel covers. Lay the covers upside down so their retaining tabs are sticking up. Then, using pliers, bend the tabs out to make a tighter fit between the wheels and covers. Use a rubber mallet to seat covers firmly on the wheels. If the click or grind is no longer present, it means one or more of the covers had been "walking," as it's called.

PM CAR CARE



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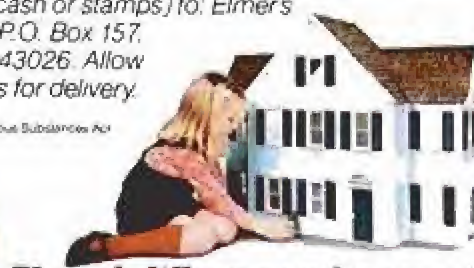
It's specially made to penetrate both hard and soft woods, grabs instantly, yet you can still realign the joint before it sets. After drying, it forms a heat and water resistant bond that's stronger than the wood itself.

Elmer's Carpenter's Wood Glue is also sandable, paintable and resistant to gumming. What's more, its solvent-free, non-toxic^{*} formula quickly washes off hands and wood with water.

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A&C GRENADIERS—THE TASTE LEADER

verification) requesting a refund. He and the four other dealers said that after 12,000 miles or 12 months, the responsibility for repairing the car was mine. Who forgot to tell these dealers that they were supposed to extend the warranty?—Fred Reimers, Wharton, N.J.

I did, and I apologize for causing you and others an inconvenience. The extended warranty does not apply to 1980 models—just to 1978 and 1979.

Pedal pushers

The accelerator pedal of my 1976 Ford LTD (351-cu.-in. engine) binds when the pedal is pressed about halfway. I must then exert extra pressure to get the pedal past that spot. I took the car back to the used-car dealer, and his mechanic told me he had to clean varnish off the metering-rod cam.

Everything worked fine for a couple of weeks. Now, the bind is back. A lady at work told me she has the same problem with a 351-cu.-in. engine in a 1977 Ford. Surely, there must be some significance in this.—Devern W. Bateman, Manchester, Mich.

There is, and also in the fact that there are several Ford service bulletins which apply. The trouble afflicts

1976 and 1977 Ford, Lincoln and Mercury models equipped with the 351M and 400-cu.-in. engine, except the 1977 400-cu.-in. California engine.

Ford describes the problem as "a binding condition between the high-speed bleed metering-rod yoke lift rod and the high-speed bleed cam (actuator), located between the throttle shaft assembly on the carburetor"—which is just a confusing way of saying: Replace the high-speed cam in the carburetor with a new cam. The part number of the new cam is D7AZ-9A965-A.

But there's more to this story. Installing the new cam without following the explicit installation instructions in Article 1773-S1, Service Bulletin 137 (6/24/77), will relieve the condition temporarily, but the binding will soon return. If I were you, therefore, I would have a Ford dealer who has access to service bulletins do this job.

GOT A PROBLEM WITH YOUR CAR?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be published in the column.

SERVICE TIPS

■ You may find that you can't get at the distributor hold-down nut of the 1982 Cadillac Cimarron, Chevrolet Cavalier and Pontiac J2000 with your old distributor wrench. The power-brake booster and air hoses may be in the way. If you can't loosen the hold-down nut, you won't be able to time the ignition or remove the distributor for repair. A distributor wrench that is shaped to do the job carries part No. J29828. It's available from Kent-Moore Tools, 29784 Little Mack, Roseville, Mich. 48066 for \$17.25.

■ Don't accept a spark knock as normal if, after making the usual adjustments in your 1981 Chrysler Corp. car or pickup truck, you can't get rid of it. Chrysler informs us that a spark knock with the engine warmed up to normal operating temperature is probably caused by a malfunction in the fuel-control computer (O₂ feedback) circuit. Specifically, the O₂ (oxygen) sensor may be defective, or a wire or connection between the sensor and computer may have a short. Have the dealer check it out according to service bulletin 08-05-81.

■ Ford announces that rough engine idling with 1979-80 five-liter (302-cu.-in.) engines may be caused by defective camshafts. After checking the obvious reasons for rough idle, as outlined in article 152 of Motorcraft Service Bulletin 11, remove the valve cover and loosen and retighten each rocker-arm fulcrum bolt, one at a time. If engine idling improves as one of the bolts is loosened, Ford says the camshaft is faulty and should be replaced. **PM**

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STRIPPING

LOW-EFFORT,
DOOR-CLOSING
MECHANISM

ONE-PIECE
BODY SIDE STAMPING

NO-GREASE DOOR HINGES

New assembly techniques and closer tolerances are being used to improve the fit and finish of J-cars. These new systems require new ways of tackling old problems. In some cases, this means adjusting components that were designed to be nonadjustable.

by Paul Weissler

Net build. It's a term you'll be hearing a lot in the years to come, as Detroit tries to build cars that overcome its past failures in fit and finish of the body. General Motors' new J-cars are the first American cars to get a big dose of the "net build" treatment.

Net build is a process which ensures that parts, most notably doors, hoods and trunk lids, shouldn't need adjustment after

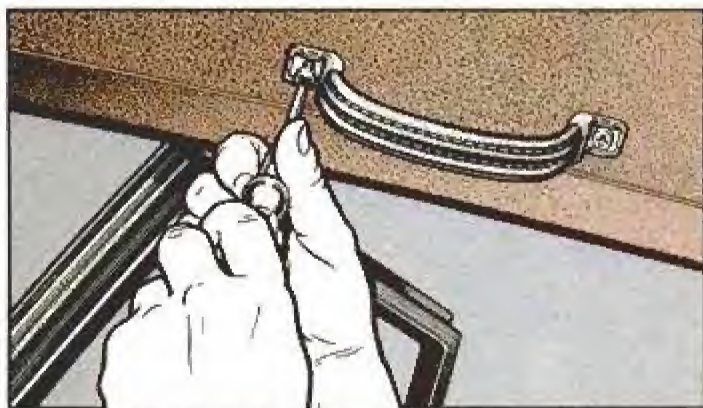
original assembly at the factory. By employing various new production techniques, parts are made with such tight tolerances that all an assembly-line worker has to do is bolt them together and they're in perfect alignment. And they'll stay that way for the life of the car, says GM.

You can't believe it? Poor fits and finish are a matter of record for Detroit automakers and only recent-

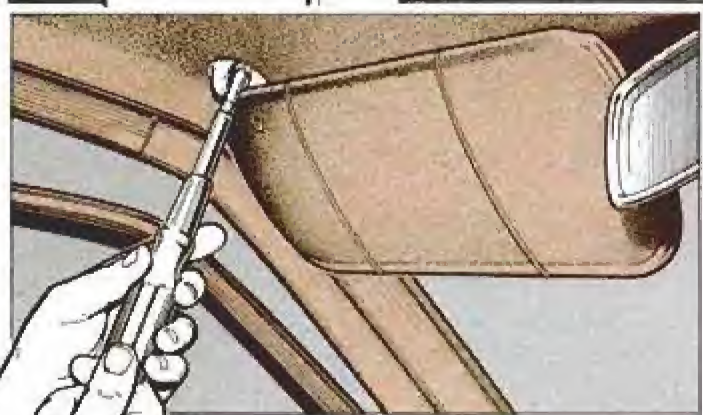
ly, due to foreign competition, has that area become so important.

Much of the bolt tightening, in fact, is done automatically. Inspectors on the line just recheck torque on critical fasteners manually.

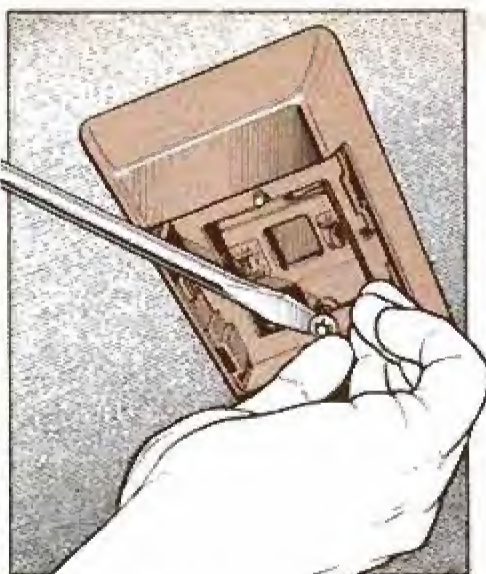
The whole system, down to a deluxe paint job, looks great on paper and, it is hoped, will result in cars that you're not ashamed to drive out of the showroom. But what happens down the road, when the



First step in removal of the headliner is to take off grab handles. These are fastened by Phillips-head screws which are covered by plastic inserts. Snap out the inserts and take out the screws.



Sun visors are taken off next. Brackets for the visors go through the headliner, and the complete assembly is held in place by Torx screws. You'll need a Torx-head screwdriver to remove them.



To remove the dome light, take off the lens and bulb, and then pry off the speed nut with a small screwdriver.

car is in a fender-bender, or if a playful child runs a sharp toy along the headliner?

Body service on the new J-cars, whether routine maintenance or repair, is different in many ways from older, more conventional cars with which you may be more familiar. Here are the differences, and what they mean when you have to perform services in which body parts are involved.

At the doors

Because you spend much time very close to, or operating, a car door, the J-car doors have special engineering. You should notice immediately the extremely low door-closing effort—just a light push and the door thunks closed. It takes only 6.5 pounds of effort to close the door. Most cars take over 15 pounds.

A major reason for the low effort is an extremely soft weatherstrip (also used at the trunk). This weatherstrip is hollow, so although it has plenty of sealing surface, it doesn't pose much resistance.

If you look closely, you'll see pinholes in the weatherstrip. These are breather holes; not a sign of deterioration that should be "patched" with a clear sealer. If you make the mistake of sealing them, the door-closing effort will rise.

If the weatherstrip ever needs replacement, get the same type, or you'll find the door-closing effort will be much greater. There's no way to "preserve" this weatherstrip, ex-

cept to avoid cuts and other physical damage, so don't lube it with silicone spray.

Another contributor to low door-closing effort is the lubricant on the latch. If you look quickly, you won't even notice the lube and may be tempted to smear on a thick coat of grease, as you'll find on most cars today. Don't. Grease is used to protect the door latch as the car goes through the paint shop. On the J-car, the latch is installed after the car is painted, so only a thin film of grease is needed. If you find the latch dry, spray with silicone lubricant or apply a thin film of multipurpose, water-resistant grease.

Door alignment is one of those net-build items—almost. One half of the hinge is welded to the door and the other half is bolted to a plate welded to the body. The door striker is bolted in place.

If the body is damaged and the door doesn't line up to your satisfaction, unbolt it from the body and enlarge the holes in the hinge with a file to provide a range of adjustment. If the bolt threads into a hinge hole from the inside of the car, you will have to secure it with a nut.

Here's how to remove a door and the hinge parts:

1. **Remove the inner door trim panel and water-deflector sheet.** Next, disconnect the wiring harness from the parts in the door, pull the rubber harness housing from the door, and then pull out the harness.

2. **Protect the area above the lower hinge, on both door and body pillars.**

Use a suitable tape, preferably a body tape with cloth backing.

3. **Remove the door hinge spring.** There's a special GM tool (No. J-28625) to compress the spring, but you may find it easier to use an inexpensive spring compressor (No. 21900) made by Steck Manufacturing Co., 1319 West Stewart St., Dayton, Ohio 45408, and sold by auto-parts jobbers specializing in body service tools. (You can remove the spring with a screwdriver. However, it is not light and getting it back in without a tool is very difficult.)

The Steck tool works somewhat like a strut coil-spring compressor, and also works on the X-car hinge spring. If you insist on trying to do the job with a screwdriver, wrap the spring with a small cloth to reduce the chance of its flying off and hitting you. Then insert a long, flat-blade screwdriver under the link that holds the door open, under the link pivot and over the top of the spring.

4. **Hold the cloth-wrapped spring and lift the screwdriver to get the spring off.** (Don't push against the link that holds the door open.)

5. **Now take out the clip that holds the hinge pin.** Don't just dig it out, or you'll ruin it and have to scout around for a replacement.

With two small screwdrivers, spread the clip just enough to get it out of its recess and toward the pointed end of the hinge pin. If it doesn't just fall off the pin, slip it off.

6. **Have a helper support the door at the rear while you take out the lower hinge pin.** Tap with a soft-head hammer on the pin and pull on its head with locking pliers. Put a thin bolt in the lower hinge to hold the door, then remove the upper hinge pin.



To release the molding, unbolt the seat-belt bracket by undoing the Torx bolt. After the job, retighten the bolt securely.

Refit the clips to the pins. When you put the door back on, install the upper hinge pin first (pointed end up). Keep a thin bolt in the lower hinge to hold the door.

Install the lower hinge pin, pointed end down, with the door in the wide-open position, and using the soft-head hammer and locking pliers. Tap hinge pins home with a drift and ball-peen hammer.

Install the compressed door spring, remove protective tape and refit the door-lock harness and housing, inner panel and water deflector.

If you want to remove the body side hinge strap, such as for hole enlargement to permit adjustment, do it with the door off. Scribe the outline of the strap on the pillar before removal, so you have a reference for reinstallation.

To get off the straps, you must take out bolts, one installed from the passenger compartment. For access to upper strap bolts, remove the lower acoustical panel and turn the fuse box down on the left side; on the right side, remove the glove box. To get the lower ones, remove the shroud trim panel on either side; in addition, take off an acoustical patch on the right side. If you ever have to replace the door's hinge strap, scribe its location on the door pillar, and drill a pilot hole completely through the center of the welds. Then drill out the welds with a $\frac{1}{2}$ -inch bit, going in only far enough so the strap will come off.

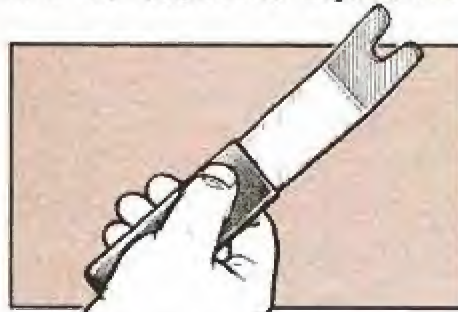
There are tapped anchor plates (that go on the inside of the door) to hold the new hinge strap. GM warns against using just nuts and bolts, which it says will not be enough to maintain the structural integrity of the hinge system.



The molding is in one piece and cannot take much flexing. Be careful not to crack it when taking it out of the car.

If the striker seems to need adjustment, remove it and look for a conical washer underneath. If you discard this washer for a flat one, you'll pick up $\frac{1}{16}$ inch of adjustment. If the factory needed the adjustment, you may not find the conical washer on your car.

The hood also has a net-build feature—no side-to-side adjustment.



Body tool (above, left) is good to have for removing the headliner snap (above, right) from the roof. If you don't have it, you can get by with two putty knives wedged on both sides of the snap. When removing the headliner (below), be careful not to let it crack as it hangs loose from the roof. If possible, have a helper support it for you.

However, there still is some fore-aft slotting in the hinges and the front rubber stops remain adjustable (turn them up or down to align hood with fenders if necessary).

Headliner

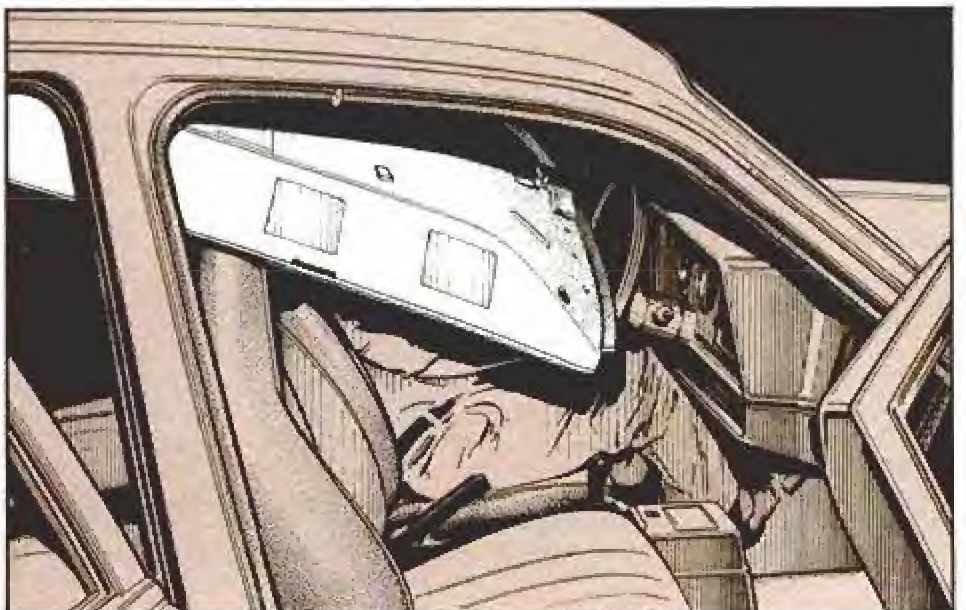
The J-car uses a molded headliner, as on many other GM late models. The one on the J, however, is super-easy to replace or to remove so you can drill holes in the roof for a luggage rack installation, for example. Here's how it's done on the four-door sedan:

1. Remove sun visors with a screwdriver. Take out the lens and remove dome-lamp frame (held by speed nuts; pry them down and off. If you're careful, you may be able to reuse them).

2. Take off the grab handles, which are held by bolts. The bolts are hidden by trim pieces, so pry off the trim with a thin rod, awl or screwdriver for access.

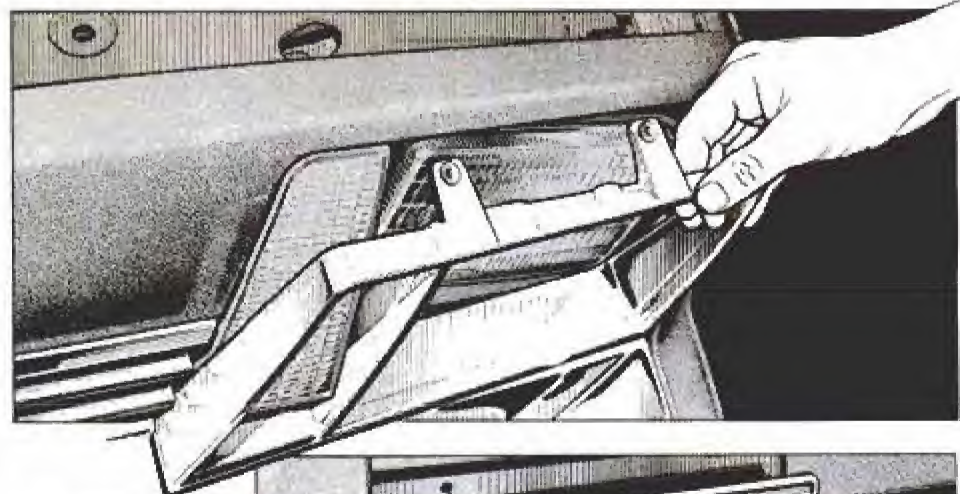
3. Take out the seat-belt bracket in the center pillar. It's held by a female Torx-head bolt, so have a set of Torx sockets handy.

4. Remove the screws that hold the plastic trim moldings around the perimeter of the headliner, down the left

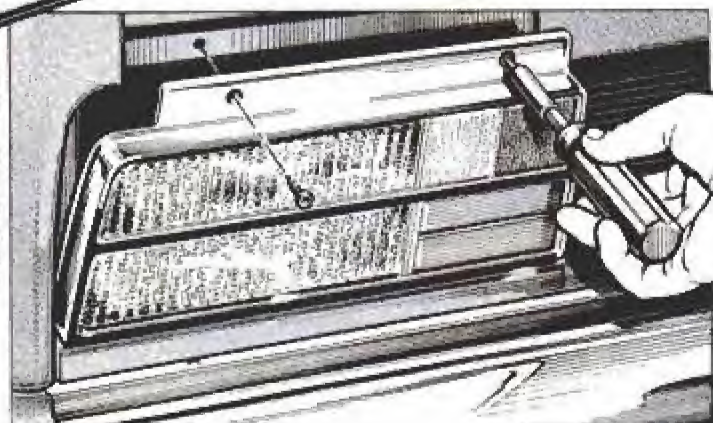




Unlike the system used in previous years, the headlight-bezel screws are removed from the engine side of the front grille.



After taking out the inside screws, pull headlight bezel forward (top). Taillight assembly (right) is flipped down on hinge after removal of two screws. This system prevents water from entering the trunk.



and right side center pillars and at each side of the windshield. Lower the trim moldings and the headliner is open all around.

Now all you have to do is disengage three plastic pins, the type used to hold inner door panels with one pin in front and two back. A special pry tool makes it easy to free the plastic pins from their retainers in the roof; you can make this tool by grinding a U-slot in the end of a putty knife. Or you can slip in two putty knives, one on each side of a pin, and pry it free.

The molded headliner is flexible, so it can be bent slightly to get it out of the car. However, don't just fold it over and push it out, or you probably will break it.

The headliner can be repaired outside of the car, by gluing on a new cover to the old foundation, using vinyl trim adhesive.

Dry trunk

Water in the trunk, the result of poor sealing, is an old story on new cars. The owner keeps bringing back the car and the shop looks for more places to apply sealer. On the new J-car, the approach was to make as few holes as possible, as small as possible, and seal them very positively. As a result, there are new procedures. Taillight bulbs, for example, don't come out from the trunk. Instead, remove two screws (Torx head) that hold the lens at the top, and let the lens flip down for access.

When you do this, you'll notice there is no big hole or holes in the rear sheet metal. The wiring goes through one small hole, sealed by a tight-fitting grommet.

If you have a wiring problem, lift

the plastic retainers in the trunk, and push out the grommet. Work the wiring out of the grommet.

Headlamp moldings on the Chevrolet Cavalier version of the J are held by hidden screws. Raise the hood and you'll find them at each side at locations chosen to protect the screws from rusting, and improve appearance if they do rust.

Body moldings

Most J-car body exterior moldings are glued in place or, if not, are held by externally mounted clips. There is none with the familiar built-in spring clip that goes through a hole in the body. Getting rid of the raw edges the body holes would produce helps eliminate the rust-out common around body moldings.

While you can reattach a loose-glued molding with epoxy, easier-to-handle adhesives are made specifically for body emblems and moldings (sold in toothpaste-type tubes).

Fluidic washer

The J-cars have a fluidic windshield-washer nozzle, a plastic part with specially shaped internal passages (no moving parts) that use water pressure from the washer pump to create an oscillating stream covering the windshield with what appears to be a spray.

Nozzles can't be cleaned with a needle; if one becomes clogged, it must be replaced.

A correct nozzle should coat the

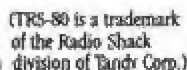
windshield from a line about 6 inches from the top to just above the lower edge. If it's off, you can make an up-down adjustment on a front nozzle with a wedge-type shim from a dealer. Place it under the nozzle one way and it raises the pattern 3°. Install it the opposite way and it lowers the pattern 3°. There's nothing to bend.

Detroit's new effort in the fit-and-finish department is just starting, and you can look forward to new techniques. However, neatness counts, particularly when people are looking in a showroom. The Japanese proved that, and Detroit knows it has to match them. **FM**

Door-hinge system is a completely new approach for GM. The hinge halves are welded as well as bolted, and provide little opportunity for making adjustments.



New NRI Home-Study Course Shows You How to Make Money Servicing, Repairing, and Programming Personal and Small Business Computers



DETROIT LISTENING POST

Lighter, sleeker 'Vette for '83

Weighing about 600 pounds less than the current model, the 1983 Corvette is expected to be powered by a throttle-body-injected (TBI) 5.0-liter V8. Chevy's zippy 2.8-liter 60° (X-car) V6, which is being adapted to fore-aft mounting for the rear-drive '82 Camaro/Firebird, is a likely option for economy-minded buyers and may later become standard. Future engine possibilities (especially if the V8 is phased out) are a turbo-V6 and either turbo- or supercharged four-cylinders. Transmission choices will be a four-speed overdrive automatic and (at last!) a five-speed manual.

Built on a 96-in. wheelbase (currently 98-in.), the revamped Chevy sportster is about 5 inches shorter and slightly lower than this year's car, with a more wedge-shaped, aerodynamically slippery profile. Although only well-disguised prototype test "mules" have thus far been seen and photographed by outsiders, reports are that its styling is "immediately recognizable as Corvette" but "flatter and less voluptuous." Hidden headlamps are retained and a rear glass cargo hatch is added. Other features include digital instrumentation and an all-new suspension with plastic transverse leaf springs front and rear.

Cadillac battles luxury imports

Introduction of the Cimarron J-car last May was only the beginning of Cadillac's overall strategy to head off buyers on their way to luxury import dealers. GM's flagship division, while not ignoring its traditional big-car customers, hopes to cultivate a whole new captive audience among the affluent 25- to 44-year-old market segment. Saying it "has some exciting stuff coming," Cadillac plans improved styling and better performance for Cimarron in the near future, and several youthful new products farther down the road.

One of the first improvements to go on the Cimarron will most probably be a throttle-body fuel injection. This should pep up the engine's somewhat lethargic performance. There's also a rumor the Cimarron may be the first J-car to have the Brazilian-made, 1.8-liter, overhead-cam engine.

Progressive introductions

With the traditional fall introductions becoming less important, do-



This converted Fairmont is one of the many alternate-fuel vehicles that Ford is testing.



The fuel tank that holds liquid methane is fitted snugly into the trunk of the Fairmont.

mestic makers (like imports) are beginning to launch new products whenever they're ready (see '82 Cars, *Detroit Shifts Gears*, page 88).

GM, for one, plans to follow this month's unveiling of little-changed large and intermediate models with a November kick-off of its X-car-derived fwd mid-size A-cars, along with carryover X-car and T-car (Chevette and T1000) and an October intro for Corvette. A third introduction for the all-new Camaro/Firebird F-cars will come in early December if eleventh-hour development goes well—even later, if not.

Ford anticipates a later debut of its new Granada/Cougar wagons, Chrysler will delay its LeBaron convertible launch beyond the planned October '81 intro, and all three companies should have additional new entries ready for next year's now-fashionable spring introduction.

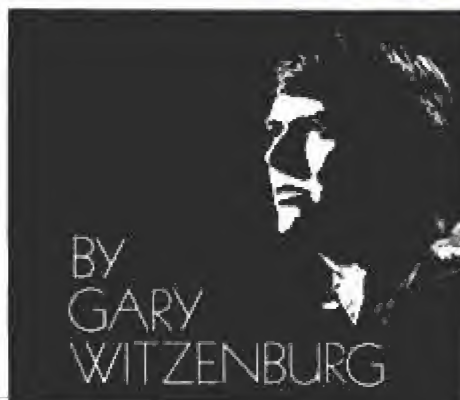
Ford alternative-fuel vehicles

Ford Motor Co. has demonstrated a fleet of experimental vehicles oper-

ating on a wide variety of alternative fuels as part of a continuing research and development program. It plans to begin marketing propane-powered cars in Canada in the '82 model year. Besides propane, alternate fuels under investigation include alcohols (ethanol and methanol), compressed and liquefied natural gas and, yes, electricity.

The company's ultimate goal, according to its vice-president of vehi-

(Please turn to page 62)



Gas Saver Tested & Patented

DENVER—The Copley News Service reported that United States Patents have now been issued to Wm. Trevaskis, California veteran electrical engineer, for his Vapor-Jet® brand water vapor injector.

Trevaskis has developed what amounts to a 20 cents per gallon "rebate" potential on gasoline, by designing a low-cost injector for automobiles, light trucks, vans and recreational vehicles.

The Vapor-Jet® system has test results showing miles per gallon improvement of 17.3 per cent on Trevaskis' 1971 Ford Galaxy and 13.3 per cent on his 1973 Olds Starfire.

Water injectors were developed to a highly refined state during World War II, to give combat planes increased speed and extended range. However, up to now, the low price of gas and the high cost and extremely difficult installation required for earlier injectors combined to make them unattractive.

The Vapor-Jet® has an unconditional 60 day guarantee.

How does the Vapor-Jet® system work?

Vapor-Jet® operates very simply with no moving parts to wear out. It uses engine vacuum to pull outside air through a reservoir containing a water/methanol mixture which is attached to the car under the hood. This causes the fluid to bubble and a mist to form in the upper part of the reservoir. This mist is then drawn by vacuum through a hose which is connected to any intake manifold suction hose. This connection is made very simply by our exclusive hypodermic-like injector nozzle which contains a regulator to allow just the right amount of mist to pass into the combustion chamber.

The introduction of this mist into the fuel air mixture has a cooling effect that increases the mixture density, extends the burning rate, and improves combustion efficiency. This eliminates ping (predetonation) and dieseling (after running of motor). Since steam is a good cleaner it also helps dissolve carbon deposits on the spark plugs and cylinder walls of older vehicles and helps prevent carbon buildup in new ones.

How much mileage increase can be expected?

This varies from car to car. Independent testing on Trevaskis' car obtained improvements from 13.3% to 17.3%.

Will Vapor-Jet® fit all cars and is it

easy to install?

Yes. Vapor-Jet® is easily installed on all domestic and foreign cars, vans, light trucks, R.V.s, campers, motor homes, and small boats. It will work on fuel injection, lean burn cars and cars with turbo chargers and super chargers and rotary engines. It will also work with unleaded gas, gasohol, or propane burning cars. The same kit fits all cars and contains everything needed. Simple installation instructions with a diagram are included and even a novice should be able to install it in less than 15 minutes. Simply take an ice pick or drill and make a small hole through any intake manifold suction hose (i.e.; PCV hose, brake assist hose, vacuum advance hose, etc.). Screw the injector nozzle into the hole, mount the reservoir by means of the bracket and screw supplied and connect the reservoir to the injector nozzle by means of the hose supplied. If you don't want to install it yourself most service stations will for a few bucks.

Can Vapor-Jet® damage my engine or cause rust?

Absolutely not! Vapor-Jet® cools down the fuel air mixture giving a better burn and suppresses ping thus aiding your engine. The mist that enters into

the engine turns immediately into vapor and exits out the exhaust.

What is the purpose of the methanol V.I.M. (Vapor Injector Mix) and how long does it last?

The reservoir measures 3½" x 5½" x 7½" and holds just under ½ gallon. A full reservoir should last about 1,000 miles. Methanol (wood alcohol) is mixed with water mainly to prevent freezing and to keep the injector nozzle clean in non-freezing weather. The cost of methanol is minimal (about \$5 a gallon). One gallon will last 8,000 miles. Sources of methanol are chemical supply houses, paint stores and drug stores. Substitutes are gas line antifreezes that contain methanol such as "Heet".

For purchase, or further information, write or call Progressive Energy Corp., 3148 So. York, Englewood, CO 80110, (303) 762-1385, or call toll free (800) 525-8624. Dealerships available.

(Offer void in CA.)

Enclose \$29.95 + \$3.00 shipping and handling.

☐ Check ☐ C.O.D. ☐ VISA ☐ Mastercard

Card No. _____

Name _____ Exp. Date _____

Address _____

Total _____



DETROIT LISTENING POST

(Continued from page 60)

cle research, Thomas J. Feaheny, is to be prepared for whichever fuel eventually becomes a viable alternative to gasoline, so that "Ford will be able to build vehicles with powerplants that will operate efficiently and economically on that fuel."

Regarding electric and hybrid (gas/electric) vehicles, Feaheny said: "While we don't consider this to be as promising as the alcohols and gaseous fuels, electricity will certainly have a role in our transporta-

tion future. We have an active research program underway. However, many technological issues must be resolved before we can commit to a production program. This certainly would not occur until the late 1980s."

Ford began production of a propane-power option for medium and heavy-duty trucks in May, and Ford of Canada plans to debut a propane option soon for '82 Granadas and Cougars. Both are the first such offerings from a major North American automaker.

According to the company, pro-

pane is readily available in the United States and Canada, and costs about one-third less than gasoline or diesel.

Full-size Chevys to be out?

Rumor is the Chevrolet Div. may follow Pontiac's lead and discontinue its full-size Impala/Caprice during the '82 model year. That would mean only GM's prestige Oldsmobile, Buick and Cadillac Divs. would get the new downsized, fwd '83 family cars scheduled for introduction a year from now. Another rumor, however, indicates that Chevrolet dealers may be offered the new fwd Olds, and Pontiac outlets would market the Buick version, so all would retain a full range.

Public ready for microminis?

One in five people responding to a recent J.D. Power *Automotive Consumer Profile* survey indicated they would either definitely or probably consider buying a smaller-than-subcompact "micromini" when such cars become available. This could encourage the Japanese, who already sell a substantial number of tiny commuter cars in their home market, to invest in preparing them for U.S. exportation and should (we hope) light a fire under the domestic makers to get their own micros ready in time to compete effectively.

Japan's microminis include cars like the Suzuki 6X and Daihatsu Mira Cuore (see *Imports & Motorsports*, page 84, Nov. '80).

Coming: GM three-cylinders

While Pontiac Div. works on smaller-displacement versions of its highly successful 2.5-liter Four (for use in future J- and X-cars as well as in the two-seat, mid-engine P-car), Chevy and Buick are building high-technology, high-economy, three-cylinder engines for still-smaller future products.

Of the two, Buick's appears closer to production and may be ready by the '83 model year. It may find use in lightweight, base-model J-cars, but is intended primarily for tiny commuter vehicles such as the proposed '84 S-car (see *Imports & Motorsports*, page 8).

Though it's basically half of Buick's V6, the three-cylinder incorporates many new ideas, including a special, high-efficiency combustion chamber. Both diesel and turbocharged versions have been included in its development from the beginning. Fuel economy estimates for a two-seat S-car powered by a three-cylinder diesel range as high as 40 mpg city, 60 mpg highway. **PM**

ZIPPITY JACKET. ZIPPITY VEST.

Buy any two Gabriel shocks or struts.
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And now when you buy any two Gabriel shocks or struts, you can save \$50 on a warm winter jacket. The sleeves zip on for a

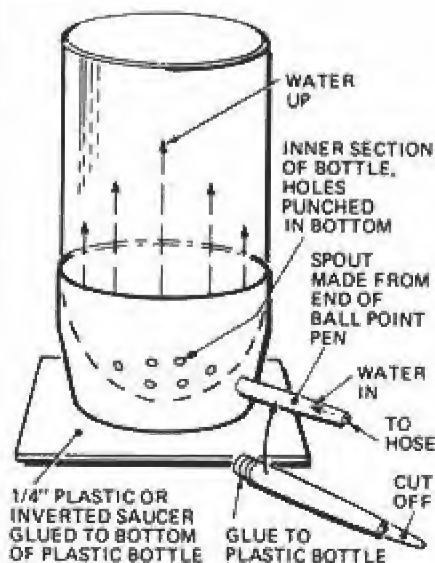
jacket, off for a vest. Available in red, blue, or tan, in four sizes for men and women.

Zip on over to any participating auto parts store or service station where Gabriel shocks and struts are sold. Offer good through October 31, 1981.

Gabriel
On the road ahead.

PHOTO HINTS

Fizzed-out washer



To make this washer, use a double-construction beverage bottle with a rounded inner bottle and a plastic shell around bottom. Cut off top and poke holes in inner bottle. Punch a hole in outer shell and cement a spout made from a ballpoint pen to shell glued to platform. Attach a hose to spout. Stack film reels inside bottle, set washer in sink and let upward-rushing water overflow bottle as it cleans film.—*Henry Flegly*

Big dust-off

To clean a mirror or lens that lens paper can't reach, rub a nylon comb (or nylon bar) through your hair or on wool. Charged with static electricity, it will attract dust when held above mirror or lens. Be careful not to touch surface.—*Bernard Shomstein*

PART TIME or FULL TIME SHARPENING BUSINESS!

YOU Can Earn Up To **\$800** An Hour In **YOUR OWN**

No Selling, No Inventory...Year Round Cash Profits and YOU Set The Hours!

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Belsaw SHARP-ALL does all these jobs quickly with precision and at a big profit for YOU. You can become Sharpening Headquarters for carpenters, builders, lumber yards, factories, home workshop hobbyists. And, you can start this Money-Making business for less than \$50.

FREE BOOK tells how to start your own sparetime business while you are still working at your regular job. People bring in their work and pay Cash—over 90c of every dollar you take in is cash profit.

Does The Belsaw Pay?
YOU BET!

JOIN THESE SUCCESSFUL SHARP-ALL OPERATORS—

\$4,000 a Year

"Think the world of my SHARP-ALL. Am now grossing about \$4,000 a year part time, and hope to expand shortly. Now doing work for the State of New York, Carrier Corp., and General Motors."

Leverette Stevenson
E. Syracuse, New York 13207

Wanted to Retire

"I had dreamed of retiring for years, but was afraid to quit my salaried job. I had never used this type of equipment, but the SHARP-ALL was real easy to learn. I sharpened 30 blades my first week — without advertising at all. Now, for the first time in my life, I can say that I am content."

Forrie Corns
Willington, Texas 75092

\$5.96 an hour

"On Saturdays, my big day, I take in \$45 to \$55. Other days I average less, but I figure I make between \$5 to \$6 per hour... and sometimes more. I am presently enlarging my shop, and thank Belsaw and their fine equipment for making it possible."

V. O. Miller
Robert, North Carolina 28589

Had to Quit His Job

"Bought my SHARP-ALL four years ago, and it has done everything (and more) than you said it would. I never sharpened a saw in my life, but when I had to quit my regular job, I knew I had to have something to do. Now I have more work than I am able to do — I have as many as 100 saws ahead of me at a time."

Frank Sartin
Grandview, Washington 98030

100% Disabled

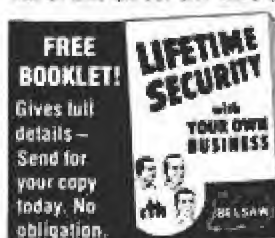
"I was disabled by an accident while employed as an iron worker. They declared me 100% disabled and said I'd never work again. I don't think I could work for anyone else but I started my sharpening business part-time and now it's turned into a full-time job with more work than I can do."

Tampa, Florida 33614



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You risk nothing by accepting this offer to see how easily you can turn your spare time into Big CASH Profits with your own Complete Sharpening Shop. Send coupon or mail postcard for full details on our exclusive 30-Day Free Trial Offer!



Our Free Book tells how to start a profitable, lifetime home sharpening business, how we help you grow, how we'll finance you.

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SCIENCE WORLDWIDE

The termite invasion

Scientists in four southern states and Hawaii are drawing battle lines against an insect which one expert calls "the most damaging termite in the world."

Entomologist Philip Koehler tells PM that the Formosan termite, native to Japan and China, can tear at the core of buildings and trees six times faster than native termites. It survives standard doses of insecticides and builds hard nests in floors and walls. The insect absorbs humidity in the house from sources such as showers and leaks in the roof.

Koehler says the small, pale white termite also may pose a threat to the orange, lemon and grapefruit industry in Florida, where the insect has attacked a woody, citruslike shrub called *ligustrum*.

The termites have established colonies in Louisiana, Texas, South Carolina and Hawaii, as well as Florida. Current treatment: Tear out the nest and soak the ground with an expensive double dose of insecticide.

Chilling computer chips

The next generation of computer chips will be hot: They're expected to generate up to 50 watts of heat per square centimeter. So computers will need the equivalent of a lot of ice chips to work.

Or a tiny refrigerator. The device you see below is just such a Lilliputian icebox, capable of cooling electrical components and scientific specimens to -310°F .

The principle behind the invention of Stanford physics professor William A. Little is the same as the principle behind all gas refrigera-



Sandia technician with radiation-protected parts: Surgical garb lessens dust hazard.

tors. Nitrogen at high pressure expands after passing through a small opening. It cools as it expands. The cool gas then passes through a heat exchanger which pre-cools the incoming pressured gas, magnifying the effect of the refrigerator.

The invention, marketed by MMR Technologies of Mountain View, Calif., can also be used to chill solid-state lasers and infrared detectors. Later generations of the refrigerator should permit the use of superconducting devices outside of a laboratory. Superconductors are extraordinarily efficient electrical devices whose frigid circuitry offers almost no resistance to the flow of current.

Armor against Jupiter

The delicate electronic parts shown above can withstand a lashing of radiation and still help transmit data about our solar system and the planet Jupiter to Earth.

Sandia National Laboratories, a subsidiary of Western Electric, supplies the radiation-hardened components for the spacecraft Galileo. Some 15,000 such components from Sandia—microprocessors and computer-memory units—will be aboard when Galileo blasts off silently from a space shuttle. Launch date is 1985.

Low temperatures during manufacture make the devices hardier. The surgical garb worn by the technicians and continuous air filtering help prevent tiny Earth-bound dust particles from fouling the intricate circuitry. Some features in the space probe's components are as small as .0002 inch.

Galileo's instruments will mea-

sure and transmit information about the surface of Jupiter. The radio stream to Earth may also contain information on the origin and development of the solar system.

Acid rain: Lakes fight back

Droplets of acid rain can corrode cars, attack paint jobs and masonry and kill fish and plant life in lakes. But a chemist at the University of Massachusetts suggests that some lakes, at least, have the ability to fight back.

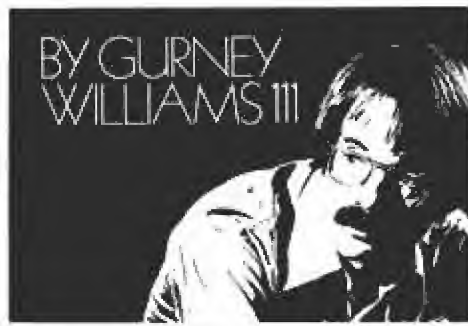
According to chemist Oliver T. Zajicek, lakes have a natural defense system: clay, micas and asbestos. These compounds contain weathered aluminum silicates—chemical compounds that neutralize or buffer acid and render it harmless.

Acid rain results from contamination of clouds by air pollutants. In just one area of the country—upstate New York—rain from such clouds has wiped out life in more than 200 lakes.

Zajicek suggests that silicates have protected many other lakes. But he warns that no one knows how long these basins can hold out against further acid attack. **PM**



MMR Technologies' tiny refrigerator may allow commercial use of superconductors.

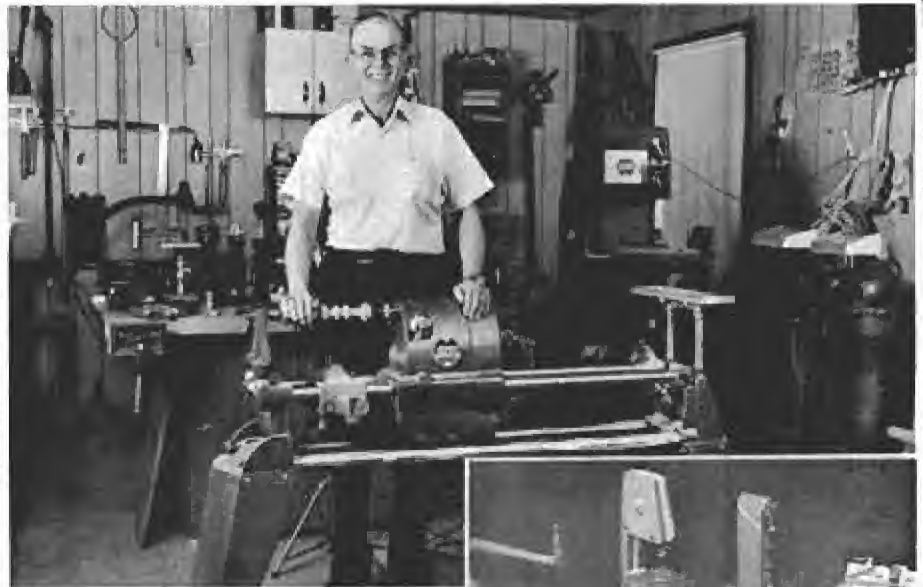


Jack McAlister had \$12,000 worth of power tools.

Here's why he sold them.

"My shop was equipped with commercial tools in which I had an investment of \$12,000 or more. I sold all my machines at a nice profit, and purchased one MARK V... I can do anything I was doing on all the machines, this gives me a lot more room and I have several thousand in the bank. What more could I ask for?"

— Jack McAlister,
Tucker, Georgia



The above quote was taken from a letter Jack McAlister wrote to us a year ago, shortly after acquiring his MARK V. Jack wrote us again recently to bring us up-to-date on how he feels about his favorite woodworking power tool: "After working with the Shopsmith MARK V for over a year, I feel that this machine is an engineering marvel. I could not be more pleased with the equipment, I get along fine without the tools I sold, but I don't think I could ever do without my MARK V." Jack found out something that a lot of woodworkers at all levels already knew. You don't need a shop full of expensive power equipment to do just about any job you could imagine. All you really need is a Shopsmith MARK V.

The 5-in-1 tool that does it all

The Shopsmith MARK V is actually a complete workshop in a single, compact unit that takes less room than a bicycle to store. It includes the five basic power tools no home shop should be without: a **table saw, vertical drill press, horizontal boring machine, lathe and disc sander.** It does everything you could do on the five tools it replaces... and more! You can do things with the MARK V that you just can't do on individual machines (even when those single purpose machines are used in combination). It actually lets you "share" features and setups from one function to another.

Precision and accuracy are built-in!

Because the Shopsmith MARK V has been designed to do many things and do them all well, we've engineered it with features you won't find anywhere else. Jack calls it "an engineering marvel" and we hear that phrase from many of our MARK V owners. They are successful

woodworkers who appreciate a tool that gives them the precision and accuracy necessary to do quality projects.

It gives you power to spare!

Your five most-needed woodworking power tools are powered by one rugged 13.5 amp motor that develops more than 2 hp. And it has a variable speed control that provides speeds from 700 to 5200 rpm merely by turning a dial. The belts and pulleys are safely enclosed in the headstock (and you don't have to change them to go from one speed to another).

You get the right speed for every woodworking operation. And you won't burn saw blades and drill bits by trying to "power" saw or drill at the wrong speeds.

It's economical, too

With five individual tools, you have to buy five motors, five stands and five worktables. With the Shopsmith MARK V, you only need one motor, one stand and one worktable. So, we can pass the savings on to you. And you buy direct from the factory, eliminating the profits of dealers and distributors.



Maybe it's time for you to find out what Jack McAlister and more than 250,000 Shopsmith owners already know. We'll be happy to send you all the facts absolutely free of charge.

You'll discover that the Shopsmith MARK V is easy to learn, even for a beginner woodworker... yet so versatile, precise and accurate that it's the choice of experts! Best of all, you'll see how the MARK V can actually replace \$12,000 or more in power tools, yet costs only a small fraction of that figure.

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ALL OUTDOORS

Record book

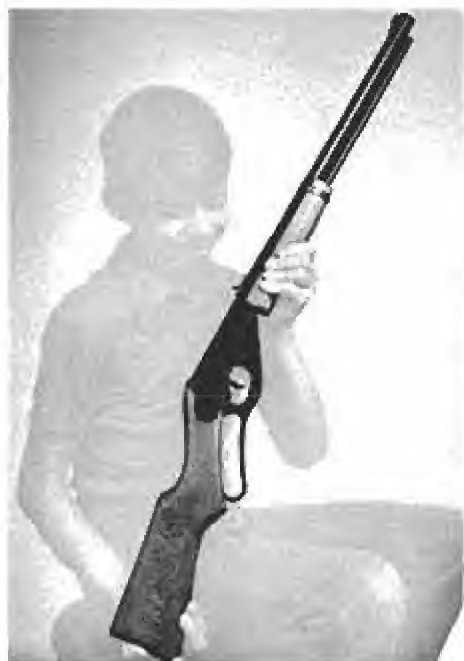
Published by the International Game Fish Assn., *World Record Game Fishes* has for years been considered the annual handbook of salt-water sportsmen. But this year, freshwater records are here as well, along with articles by experts and instructions for applying for a world's record, and now the book should be of importance to every fisherman.

While the book is available for \$6.95 postpaid from the IGFA, 3000 East Las Olas Blvd., Fort Lauderdale, Fla. 33316, a better purchase is the \$15 IGFA membership. This includes the record book plus the bimonthly news report, jacket patch, membership decal and additional publications.

Freshwater angling records by states are \$2.50 from the National Fishing Hall of Fame, Hayward, Wis. 54843.

Remember when?

Commemorative replicas of rifles and pistols have become popular as operable collectors' items. Now an air rifle old-timer, the 1940 Daisy



Commemorating youthful pleasures, Daisy's Red Ryder BB gun is again available.

Red Ryder BB repeater, is again available with hardwood stock and forearm, lariat signature on the side of the stock, saddle ring with leather thong and 700-shot positive feed. This Red Ryder Model 1938 is the one with which many shooters got

started. Originally about \$5, it's still a buy at \$36.

Double check

A couple of outdoor products deserve a second look for safety's sake. Owners of the Keny Model 110 alcohol stove should contact Kenyon Marine, New Whitfield St., Guilford, Conn. 06437, to correct a possibility of overheating.

And look at the serial number if you have a fine Ruger stainless-steel, Mini-14 rifle, a favorite of boatmen and other outdoorsmen because of its rust resistance. If the number is below 182-51929 on the receiver and there is only one proofmark, get in touch with Sturm, Ruger & Co., Dept. 14, Guild Road, Newport, N.H. 03773, or in Canada: All Sports Distributors, Dept. 14, 6015 4th St. S.E., Calgary, Alta. Firing with a bore obstruction or faulty ammunition that creates extreme pressure could crack the excessively hardened receiver. Ruger wants to re-examine the receivers and re-heat-treat them for you.

Stamp of approval

More taxes are just about the last thing that we need, but now a bill has been proposed in Congress to make one outdoor group pay for the problems of another. In the last 30 years, the Dingell-Johnson Sport Fish Restoration Act has raised over \$250 million with an excise-tax levy on manufactured recreational fishing equipment. Now congressmen want to enlarge Dingell-Johnson to tax recreational boats, motors and equipment, as well, to help out fish research and facilities. That's like taxing fishermen to improve marine engines and sail designs.

Worse still, though the Biaggi bill was finally passed last year so that taxes paid on marine gas by boatmen would be used to improve boat safety and facilities, Congress has yet to turn over any of the money. Safety, it seems, is good to talk about and vote for, but not pay for.

There are, of course, a number of other ways to raise money to support fishing. Fishing licenses and user fees are already applied, in part, to support the sport. And there is the duck-stamp approach that has supplied millions, over the years, to help Ducks Unlimited provide essential breeding grounds for migrating waterfowl. Wild turkeys benefit from a similar program. The Bass Re-



As new stamp or color print, this large-mouth aids Bass Research Foundation.

search Foundation, Box 99, Starkville, Miss. 39759, is now issuing a \$5 stamp, signed by wildlife artist Les Kouba, to enlarge its worthwhile work.

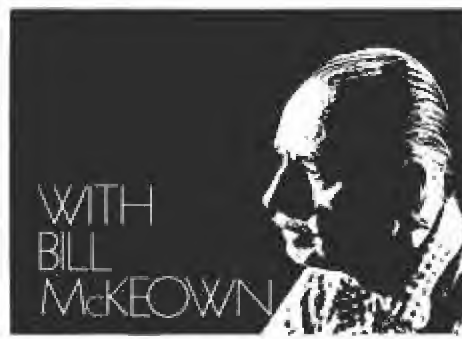
A large reproduction of the stamp, also signed and in limited edition, is \$125. These stamps, too, are likely to become valuable collectors' items while aiding a worthy cause.

N.H.&F.D.

Once a year, outdoorsmen have a chance to give indoor types a look at what sport afield and afloat is all about. The annual event is called National Hunting and Fishing Day, and this year it falls on Saturday, Sept. 26. Shooters and fishermen, hikers and skiers, boatmen, campers, swimmers, archers, cyclists and wildlife photographers all will be among those conducting demonstrations and manning exhibits to show spectator sportsmen what participation is all about. Local parks and schools, clubs and shopping centers will feature the displays.

Onlookers have been known to criticize activities they don't understand, so it is only fair to let active outdoorsmen—the ones who pay for wildlife management and conservation—explain what appreciation of the environment means. National Hunting and Fishing Day is that opportunity.

PM



when I planned to retire before fifty

this is the business that made it possible

a true story by John B. Haikey

Starting with borrowed money Duraclean gave me the opportunity for financial security...
In eight years I sold out at a profit and retired.



"Not until I was forty did I make up my mind that I was going to retire before ten years had passed. I knew I couldn't do it on a salary, no matter how good. I knew I couldn't do it working for others. It was perfectly obvious to me that I had to start a business of my own. But that posed a problem. What kind of business? Most of my money was tied up. Temporarily I was broke. But, when I found the business I wanted I was able to start it for a small amount of borrowed money.

"To pyramid this investment into retirement in less than ten years seems like magic, but in my opinion any man in good health who has the same ambition and drive that motivated me, could achieve such a goal. Let me give you a little history.

"I finished high school at the age of 18 and got a job as a shipping clerk. My next job was butchering at a plant that processed boneless beef. Couldn't see much future there. Next, I got a job as a Greyhound Bus Driver. The money was good. The work was pleasant, but I couldn't see it as leading to retirement. Finally I took the plunge and went into business for myself.

"I managed to raise enough money with my savings to invest in a combination motel, restaurant, grocery, and service station. It didn't take long to get my eyes opened. In order to keep that business going my wife and I worked from dawn to dusk, 20 hours a day, seven days a week. Putting in all those hours didn't match my idea of independence and it gave me no time for my favorite sport — golf! Finally we both agreed that I should look for something else.

"I found it. Not right away. I investigated a lot of businesses offered as franchises. I felt that I wanted the guidance of an experienced company — wanted to have the benefit of the plans that had brought success to others, plus the benefit of running my own business under an established name that had national recognition.

"Most of the franchises offered were too costly for me. Temporarily all my capital was frozen in the motel. But I

found that the Duraclean franchise offered what I had been looking for.

"I could start for a small amount. (Today, only \$2,988 starts a Duraclean dealership. The full cash price is \$9,987). I could work it as a one-man business to start, and operate from my home. No office or shop or other overhead, no salaries to pay. Equipment would fit in my car trunk. (I bought the truck later, out of profits.) Best of all, there was no ceiling on my earnings. I could build a business as big as my ambition and energy dictated. I could put on as many men as I needed to cover my volume. And I could build little by little, or as fast as I wished.

"So, I started. I took the wonderful training furnished by the company. When I was ready I followed the simple plan outlined in the training. During the first period I did all the service work myself. By doing it myself, I could make much more per hour than I had ever made on a salary. Later, I would hire men, train them, pay them well, and still make an hourly profit on their time that made my idea of retirement possible — I had joined the country club and now I could play golf whenever I wished.

"What is this wonderful business? It's Duraclean. And, what is Duraclean? It's an improved, space-age process for cleaning upholstered furniture, rugs and tacked down carpets. It not only cleans but enlivens and sparkles up the colors. It does not wear down the fiber or drive part of the dirt into the base of the rug as machine scrubbing of carpeting does. Instead it *lifts* out the dirt by means of an absorbent dry foam.

"Furniture dealers and department stores refer their customers to the Duraclean Specialist. Insurance men say Duraclean can save them money on fire claims. Hotels, motels, specialty shops and big stores make annual contracts for keeping their carpets and furniture fresh and clean.

"Well, that's the business I was able to start with such a small investment. That's the business I built up over a period of eight years. And, that's the business I sold out at a substantial profit before I was fifty."

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The Contax 139 Quartz and the Contax 137 MD Quartz are also milestones in photographic history in their own right. The Contax 139 Quartz is the world's first SLR with total quartz crystal regulation, offering unprecedented accuracy through all of its many functions, features and electronic accessories. The compact, Contax 137 MD Quartz is the world's first 35mm SLR with a fully integrated single quartz controlled micro-motor. Now all camera functions, including film advancement, are achieved without the photographer's eye ever having to leave the subject.



The Contax Multi-Flash System offers remarkable versatility for both studio and location assignments. And availability of a true off-the-camera multiple unit automatic dedicated flash capability also makes it unsurpassed in offering perfect flash results. Each unit of this system is compact and lightweight, making it ideal for photographers who are always on the move but want the lighting quality of a studio with them. In a real way, the Contax Multi-Flash System lets the photographer have a studio in a suitcase, ready for action anytime, anywhere.



The Contax Close-up System, as with all Contax accessories, offers not only the highest technological sophistication but also dependability. Its Auto Extension Bellows PC, for example, allows for full and precise adjustments offering optimum perspective plus depth-of-field control. Lenses can easily be reverse mounted which enables larger magnification ratios and, most importantly, sharper images. There is even a Medical 100 DX Macrophoto System with a magnification ratio of 1:15 to 1:1. It's ideal not only for surgical, dental and scientific work, but also for commercial photographers specializing in close-up assignments.

Among the more than 300 accessories within the ever growing Contax System are: full information data backs, cordless and electronic remote control units, microscope adapter, slide copying unit, multi-length cable switches, and more, much more. Truly, the Contax System is ready for any assignment.



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Make a lathe wiggle gauge

This wiggle gauge is used to position a workpiece on a lathe faceplate or in a chuck for accurate drilling. A pointed end of the gauge is placed in a punch mark denoting the position of the hole to be drilled. The headstock spindle is then turned by hand. If the mark is off-center, the outer end of the rod will rotate in a circle about the point of the tailstock spindle. When it's centered, the end will remain point-to-point with the spindle.

Cut a $\frac{1}{8}$ -in.-diameter drill rod to an 8-in. length. Machine one end to a sharp point (about 60°). Machine the other end to a longer taper and round its point slightly for safe handling.

Machine a steel collar to a $\frac{3}{8}$ -in. diameter, $\frac{3}{16}$ in. thick. Center-drill it to fit on the rod. Use a 6-32 setscrew to lock it. The spring consists of 10 $\frac{1}{2}$ -in.-diameter rubber washers with $\frac{1}{8}$ -in.-diameter center holes. You can cut the washers from an inner tube.

Make the holder from three $\frac{1}{2}$ -in.-thick steel bars shaped as shown at bottom right. The bars are $\frac{1}{4}$ in. wide. Make the longer bar about 4 in. long and the two shorter bars 3 in. Clamp and adjust the long bar in the toolpost so the tailstock center contacts it in the middle area of its wider end. At this point, drill a $\frac{1}{8}$ -in.-diameter hole and countersink it on the side facing the tailstock. Ream the hole carefully until the rod, when passed through it, can rotate about 8° in a circle.

Fasten the three bars together using $\frac{1}{2}$ -in. rivets, with the two short bars on the tailstock side.

How to use your gauge

To use the gauge, place the holder in the toolpost and adjust it until the tailstock center rests snugly in the countersunk hole. Attach the collar $1\frac{1}{2}$ in. from the point on the rod and add the rubber washers. Slip the rod through the hole and move the carriage toward the headstock until the rod point rests in the punch mark on



In this position, gauge shows that workpiece punch mark is aligned with lathe centerline.



A 60° point is machined on one end of the drill rod. Tool bit was inverted in holder and fed from the back for photo clarity.



Place holder in toolpost and use point of tailstock spindle to align the holder hole.



By rotating headstock spindle by hand (not shown), far end of gauge rotates about tailstock spindle as indicated by dotted line. This means adjustment is needed.

the workpiece. Washers should be slightly compressed.

Turn the headstock spindle by hand and observe the outer end of the rod. If the point of the rod rotates around the tailstock spindle point, shift the workpiece in whichever direction is necessary to eliminate rotation. Because the pointed



Parts of wiggle gauge, including safety caps for the points, are shown in front of handy storage box. Make box from $\frac{1}{4}$ -in. plywood with $\frac{1}{8}$ -in. plywood for top.

rod ends can be hazardous, you should keep the gauge in a case when it's not in use. Protective caps for the ends can be made from plastic tubing. Cut tubing to a length of $1\frac{1}{4}$ in. and shrink one end by heating over an open flame. When softness is detected, pull to shrink slightly.

—Walter E. Burton



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We've got the proof.



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SEARCHING FOR THE PERFECT .10

THE ENEMY OF MPG IS NO LONGER THE GAS-GUZZLING ENGINE—IT'S AERODYNAMIC DRAG. WIND-TUNNEL WIZARDS ARE OUT TO CHEAT THE WIND.

by Rich Taylor



In a wind tunnel, smooth trail of smoke over the top of clay mock-up Mustang indicates good airflow. Turbulent airflow creates a drag coefficient higher than .10 and robs mileage.

Like an old tuxedo that has come back in style, the study of aerodynamics of cars is being taken out of the closet, dusted off and recycled. Aerodynamic-looking cars were all the vogue many years ago. In those days—the days of the Chrysler Airflow, Cord and Pierce-Arrow—they called it streamlining. The designers were after a “look” and it was largely a matter of seat-of-the-pants aerodynamics. If it *looked* slippery, it probably was.

During the past 10 years automotive aerodynamics has really become a science. The

reason for the great emphasis on aero is simply better mileage. The world's automakers see it as one of the last unexplored frontiers in the race for better mpg.

According to recent estimates, it cost General Motors \$50 million to get a 2-mpg improvement in Corporate Average Fuel Economy (CAFE) by designing more efficient power trains. This was back in 1974-75. These days, it costs three times that figure for a ½-mpg gain in CAFE number. The big, easy gains have already been made and it's getting harder and harder to make the



THE SLICKEST THERE IS

This "banana car" is the slipperiest shape yet developed for a passenger car, with a Cd of just .20. It was designed by Prof. Alberto Morelli of Torino Polytechnic University, built and developed by Sergio Pininfarina and financed by the Italian Government.

Morelli came up with his ideas of "zero-lift" body design in the early '60s on the Pininfarina Pt-X and Pt-Y styling studies. This car's main features are a chopped-off Kamm tail, air ejectors in low-pressure areas and a constant-section body. It requires only 7 hp to maintain 60 mph on level ground, for fuel economy at least 30 percent better than a conventional sedan with the same chassis. While this car may seem futuristic and almost unbuildable, Pininfarina claims the shape can be brought into production.—R.T.

21 WAYS TO A PERFECT .10

1 AIR EJECTORS IN
LOW-PRESSURE AREA
OF THE NOSE

2 HIDDEN
WIPERS

3 SHARPLY RAKED
WINDSHIELD

4 FLUSH GLASS
(NO TRIM)

21 POINTED
NOSE

20 INTAKES IN HIGH-PRESSURE
AREAS (FOR ENGINE COOLING
AND AIR EJECTORS)

19 MOVABLE
AIR DAM

18 COVERED
HEADLIGHTS

A car with a perfect Cd of .10 doesn't yet exist. But when it is built, it will probably look very much like this, and incorporate all the aerodynamic tricks that are illustrated here.

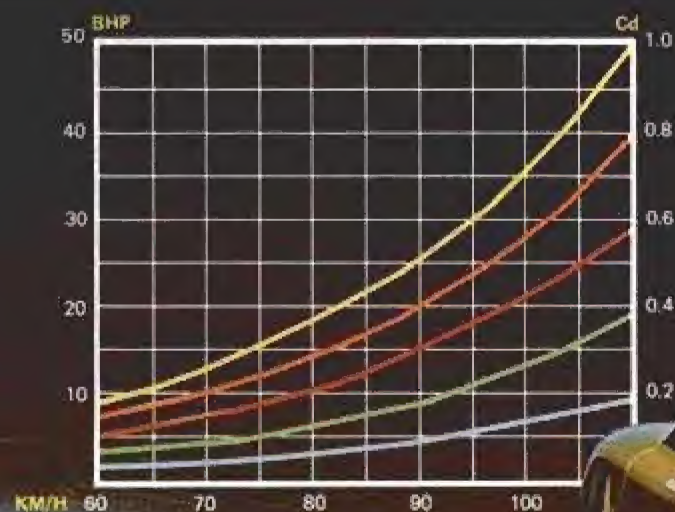
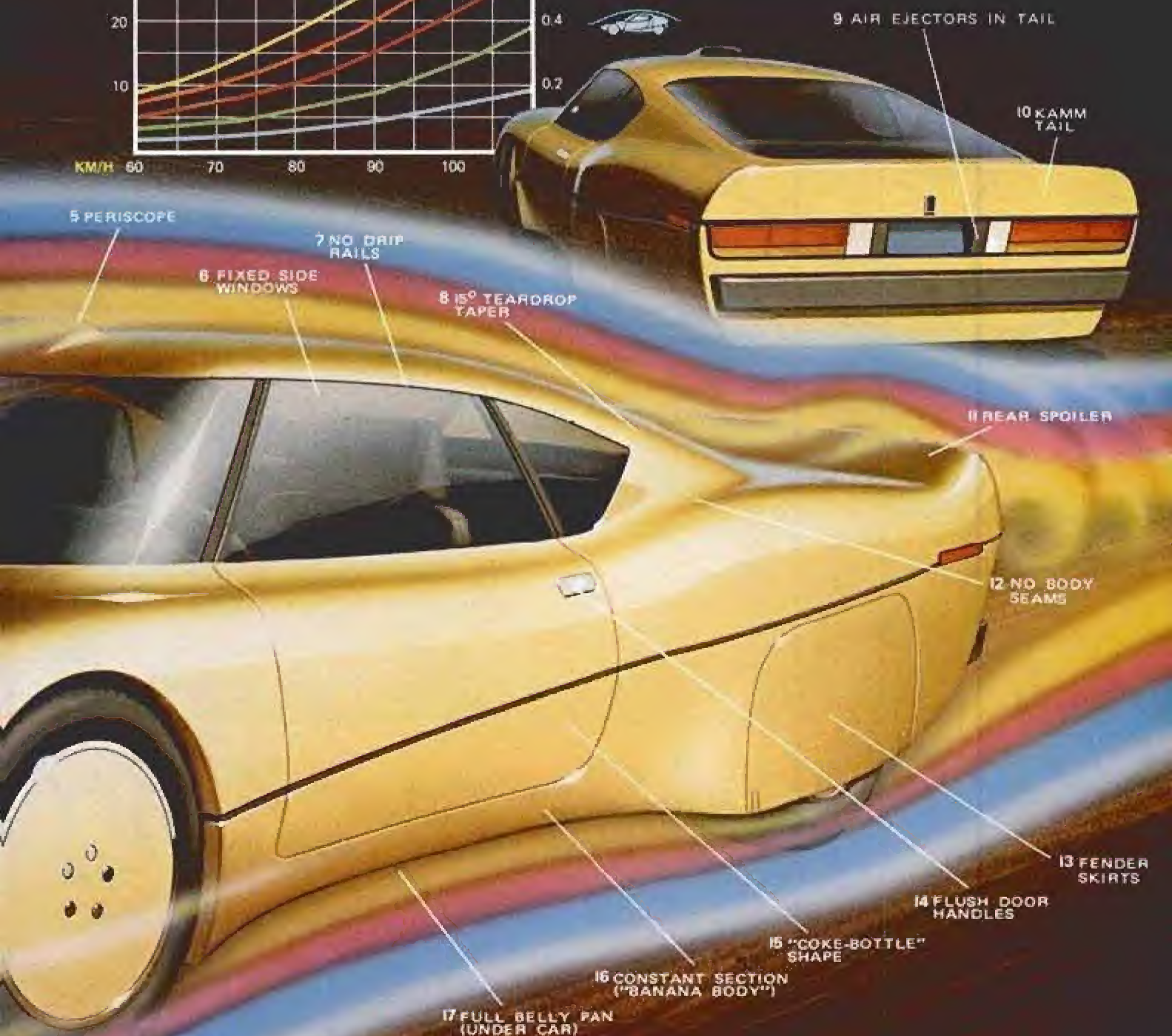


Chart (left) indicates various power needs in brake horsepower (bhp) of aerodynamically different vehicles, all other factors being equal, for speeds from 60 to 110 mph. The coefficient of drag (Cd) ranges from worst possible, 1.0, to nearly ideal, 0.2. Some design concepts in the experimental vehicle (below) are already showing up in production cars.

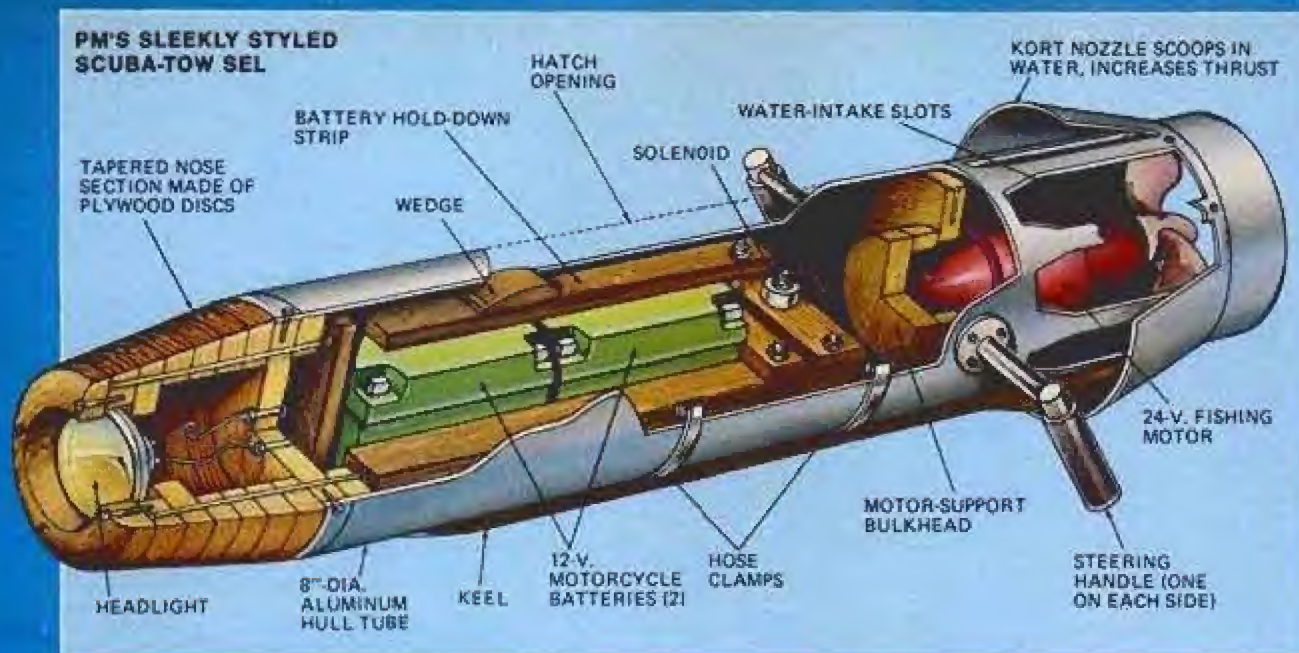


already efficient new engines more efficient.

By playing with a car's aerodynamics, however, a carmaker can achieve a 1- or 1½-mpg gain simply by bending sheet metal and not even touching the engine. And aerodynamic work is much cheaper than engineering a new engine. That 1 mpg can be bought in a wind tunnel for a few thousand dollars, compared with the hundred million dollars it would take to refine a powerplant.

It's estimated that a .06 loss in a car's coefficient of drag (Cd) equals a 1-mpg gain on the road at 55 mph. An example of how cheaply drag can be brought down is the optional decklid spoiler on the new Pontiac J-car, the J-2000. Without the spoiler, Cd was .407. With the spoiler, the Cd went down to .392, a gain of .015. This adds up to a fraction of an mpg gain—not an astounding number, but very cheap, considering the price of a spoiler compared to re-

(Please turn to page 157)



PM art: Jeff Mangiat; PM photos: Juergen Bauck, Cypress Gardens, Fla.



Build PM's exciting

Whether you like adventurous scuba diving or just lazy surface snorkeling, this self-

by Sheldon M. Gallager

Scuba diving and snorkeling are more fun with a power assist to pull you through the water. With PM's sleek, self-propelled diving scooter, you just point the nose wherever you want to go and hang on—it does all the work for you. Press a switch and you're off for hours of leisurely, effortless underwater exploration.

The scooter, powered by a small electric fishing motor, is an updated version of PM's popular Scuba-Tow II, introduced two years ago (*Great New Gear for Underwater Fun*, page 72, Aug. '79). We call the new model the Scuba-Tow SEL (for Single-Engine Lightweight). Its big advantage is that, unlike the earlier design, it requires only one

motor, instead of two. Thus, it's smaller, lighter, easier to handle and less expensive to build. Construction cost, including motor and batteries, is under \$250. Complete plans for building the scooter are available for \$9.95 (see ordering information on facing page).

The Scuba-Tow SEL is patterned after commercial diving scooters costing \$1,200 to \$2,100. It will pull you on or under the water at about 3 mph—the equivalent of a brisk walking pace. In water, that's a good clip. Two bicycle-like handgrips make it easy to steer the scooter in any direction. With a little practice, you can make steep banking turns, zoom up or down in long, graceful sweeps,



Two colorful scooters (far left) await use on the beach at famed Cypress Gardens, Fla., where PM tested the new models. With the hatch cover removed (near left), batteries are easily accessible for recharging.



PM'S SCUBA-TOW SEL

You glide through the water with the greatest of ease behind this electric-powered diving scooter built from PM plans. Using a single, tiny fishing motor, it whisks you along at about 3 mph for hours of leisurely undersea adventure.

new diving scooter

propelled water tow will make the going easier and more fun for the whole family.

even perform breathtaking loops and barrel rolls like a stunt flier.

You can use the scooter with or without scuba gear—an air tank adds to the fun and excitement, but is not a must. Since you're relieved of the exertion of swimming, you use up oxygen less quickly and can stay down a surprisingly long time without an auxiliary air supply. You can also cruise along the surface, with just a mask and snorkel, watching the magical world of marine life passing by below you.

The slim, streamlined hull is a length of 8-inch-diameter aluminum construction pipe, sealed to give a slight positive buoyancy. It can't sink or

run away from you if you accidentally let go. When you release the handles, the motor stops automatically, and the scooter floats slowly to the surface.

In testing the new Scuba-Tow SEL, we were

(Please turn to page 152)

HOW TO ORDER PLANS FOR PM'S SCUBA-TOW SEL

Complete plans for building PM's electric-powered diving scooter, including full-size cutting patterns and an illustrated instruction manual, are \$9.95 postpaid. Send your check or money order to Popular Mechanics, Dept. SEL, Box 1014, Radio City Station, New York, N.Y. 10101. Please make payable to Popular Mechanics. Allow three to four weeks for delivery by third-class mail. If you prefer faster, first-class mail, add 75 cents.

LOCKED IN A PRESSURE CHAMBER, VOLUNTEERS OPEN UP DEEP SPACE UNDER THE SEA



As NASA tracks probes aimed toward the stars, other researchers are exploring high-pressure frontiers on the Earth.

by John F. Pearson

Tucked away in a lower part of the Duke University Hospital, the F. G. Hall Environmental Laboratory is a fluorescent-lit world of imposing steel cylinders and spheres—hardly the typical site for a party.

But the laboratory became a scene of celebration shortly after 4:16 p.m. last March 6, when three young men in blue shorts and T-shirts clambered through the hatch of a cylindrical chamber and looked around sheepishly. Their appearance triggered shouts: "Hey, they're out!"

Within minutes, the cramped quarters were jammed with people, hugging and backslapping. Cameras clicked, champagne corks popped. And staff members ceremoniously dropped the white-coated Dr. Peter B. Bennett, the laboratory director, into a plastic laundry cart filled with water.

Their jubilation could not have been greater if the three had returned from an actual dive beneath the sea. Although they had never left the lab, divers Steve Porter, Len Whitlock and Eric Kramer had extended the frontiers of deep-

Duke diver Len Whitlock (right), aided by Eric Kramer, breathes oxygen through a mouthpiece during decompression. Key to the success of 43-day simulated dive was precise control of breathing gases. Addition of nitrogen, and slow compression, helped enable men to withstand pressure of more than half a ton per square inch.



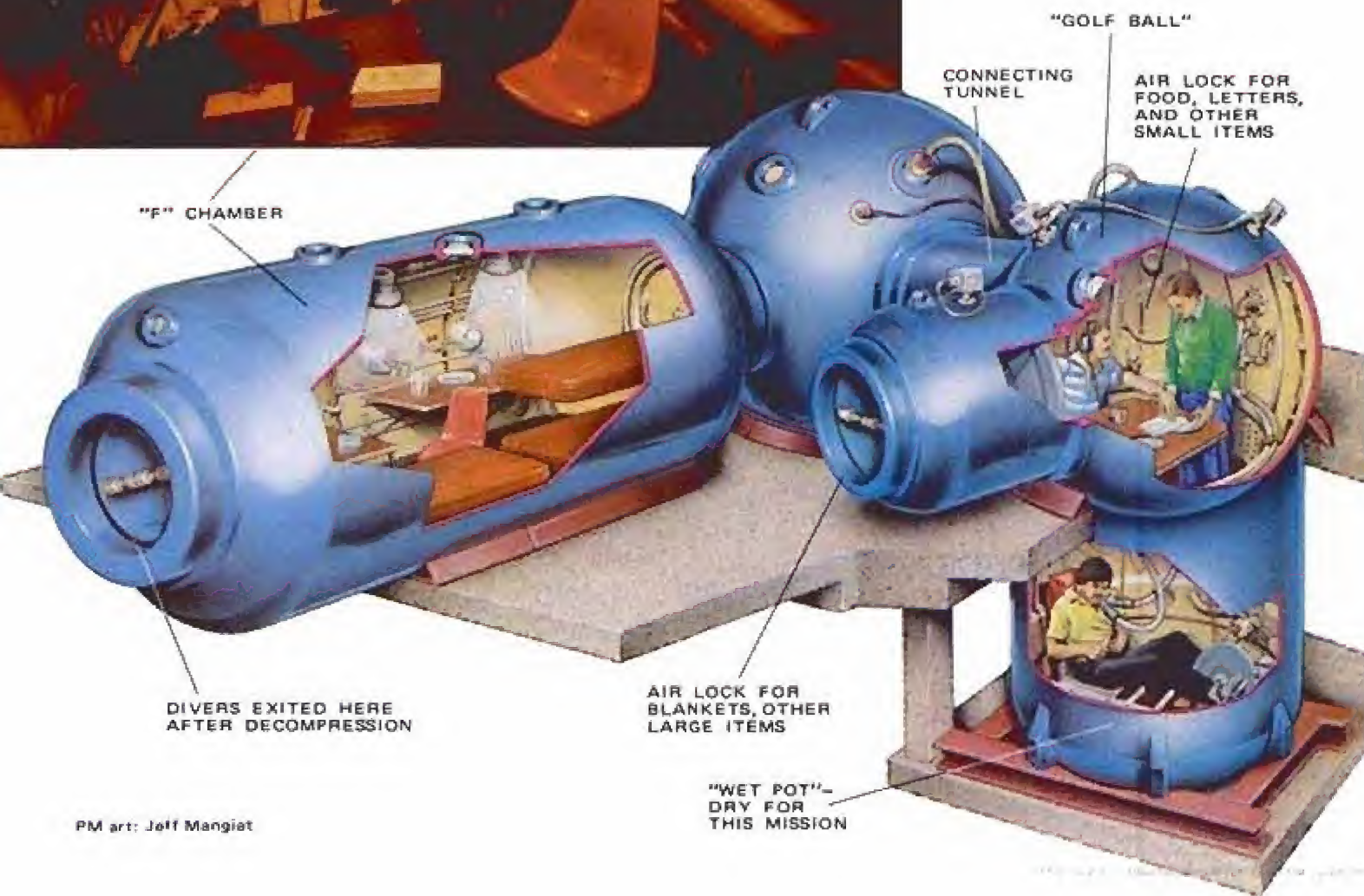
PM photo: John Pearson



The high-pressure mission was monitored continuously from control panel (above, left). After the hatch popped open, divers (above) were reunited with lab director, Dr. Peter B. Bennett (in white coat).



Atlantis divers spent most of their time in "golf-ball" sphere (below) connected to cylindrical chamber beneath. After the team had endured record-breaking pressure, it moved to comparatively large (10 1/2-foot-diameter) "F" chamber for the final stages of decompression.



sea exploration for future generations of high-pressure pioneers.

In the course of a 43-day simulated dive, the team had endured body-wrenching pressures of more than half a ton per square inch. That's roughly what a diver would encounter at 2,250 feet beneath the ocean surface. They had functioned well under the pressure. And they had provided reams of physiological data that could make similar working dives possible in the sea, extending the search for oil and mineral resources.

The record-breaking simulation was built on years of research, much of it by Dr. Bennett. The Duke Medical Center's interest in the biomedical effects of unusual environments dates to the 1940s, when investigators at the Durham, N.C., institution studied physiological responses to altitude. In 1963, the first hyperbaric (high-pressure) chamber was installed. Through the years, research expanded into eight chambers, including one that provides pressure

ing some to rip off their helmets to join fish in a carefree swim.

Since nitrogen is not used by the body's metabolism, why not remove it? That's what diving researchers did. Instead of compressed air, deep divers breathed a mixture of helium and oxygen, called heliox, and limits were extended below 300 feet. Helium caused no narcotic effect.

The development of saturation diving in 1957 introduced a further refinement. Researchers found that after a period of chamber exposure to an inert gas like helium, a diver's tissues would be saturated with the gas. No more could be absorbed. In practical terms, this meant a diver could be pressurized to, say, 300 feet

in a chamber, transferred to a diving bell and dropped to a work site at 300 feet, then returned to the chamber. The system was efficient because the diver had to face decompression just once, at the end of a work period, days or weeks long.

Though saturation diving with heliox is well established today, working dives below 600 feet are still not commonplace. Helium, it developed, was not an open sesame to routinely safe, ultradeep diving.

Odd brain waves at 600 feet

In 1965, Royal Navy divers, compressed to 600 and 800 feet in simulated heliox dives in an English lab-

(Please turn to page 153)

*At 2,000 feet, a
sneeze 'feels like
you're blowing off
the top of your head.'*

—Diver Steve Porter

exposures equivalent to 3,600 feet of water. With its clutter of steel spheres and horizontally positioned cylinders, the lab today looks as much like a ship's boiler room as a place of science.

The sophisticated complex of hyperbaric and hypobaric (low-pressure) chambers gives the laboratory great versatility. On a typical day, technicians can simultaneously monitor divers pressurized to 150 feet in one unit and birds exposed to a 10,000-foot altitude in another, while patients suffering from a chronic bone disease breathe pure oxygen at two atmospheres of pressure in a third chamber. Duke claims to be the busiest hyperbaric facility in the world.

Nitrogen as a narcotic

Until World War II, Navy and commercial divers breathed compressed air, wore the traditional portholed "hard hats" and cumbersome weighted suits and rarely worked below 200 feet. At that depth, nitrogen, an element that comprises nearly four-fifths of the volume of the air you breathe, became a dangerous narcotic. It intoxicated divers, causing them to make dangerous errors and reportedly lead-



In pre-dive practice sessions, the divers rehearse taking blood samples (top) and exercising on a stationary bicycle, while Duke researchers monitor their breathing-gas flows.

Pressure-packed WASP challenges ocean depths

A fish out of water has only two options. It can survive if it can learn to breathe air, or it can carry its own supply of water.

These options are reversed with humans in highly pressurized water, say around 2,000 feet beneath the waves. Either they learn to stand the pressure (as volunteers at Duke are learning to do), or they cart surface pressure down with them.

The WASP diving suit illustrated on this page is one of the latest pieces of gear designed to drop humans to depths of thousands of feet in protectively pressurized containers.

While it takes days to get to target depths using Duke's system of exotic breathing gases and creeping pressurization, people inside the 6-foot, 8-inch WASP can plunge immediately to a depth of 2,000 feet. They work there under one atmosphere of pressure, inside a tough shell of fiberglass-reinforced plastic. Foot pedals (similar to foot dimmer switches on cars) control electric thrusters for speeds up to one knot. When work is done, 12-mm cable hauls the WASP (which weighs 900 pounds in air) back up without decompression.

WASP's maker, Oceaneering International of Houston, tells us that amateurs can learn to use the \$250,000 to \$500,000 WASP after about half an hour of training. One of the hardest tasks, initially, is correcting for the magnification of the scene outside through the 2-inch-thick plexiglass.

The suit has some other disadvantages. It can't straddle large pipes the way a diver can, for instance: It has no legs. Its mechanically run manipulator arms are not as dexterous as a diver's arms and hands.

But the WASP is great for pipeline inspection. Its operators avoid the risk of the bends, the boredom of decompression, the panic of the fish out of water. "It works fine," a spokesman for Oceaneering says, "even for people who don't like to swim."

PM art: Ed Vallgursky



WASP diving suit is dropped into the sea on a cable, but safety systems on board enable it to function even if cable is cut. Diver could activate battery to operate thrusters. Transducer (at rear of suit) permits voice communication via sonar system. In service since 1978, WASP is used for inspection work.

NEW FOR BETTER

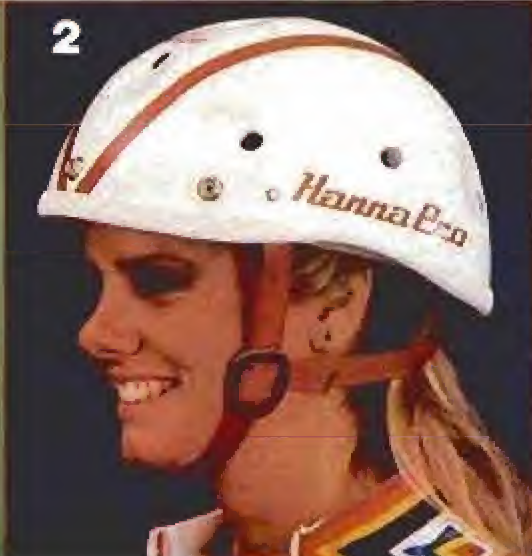


PM photos: David Gauley

1



2



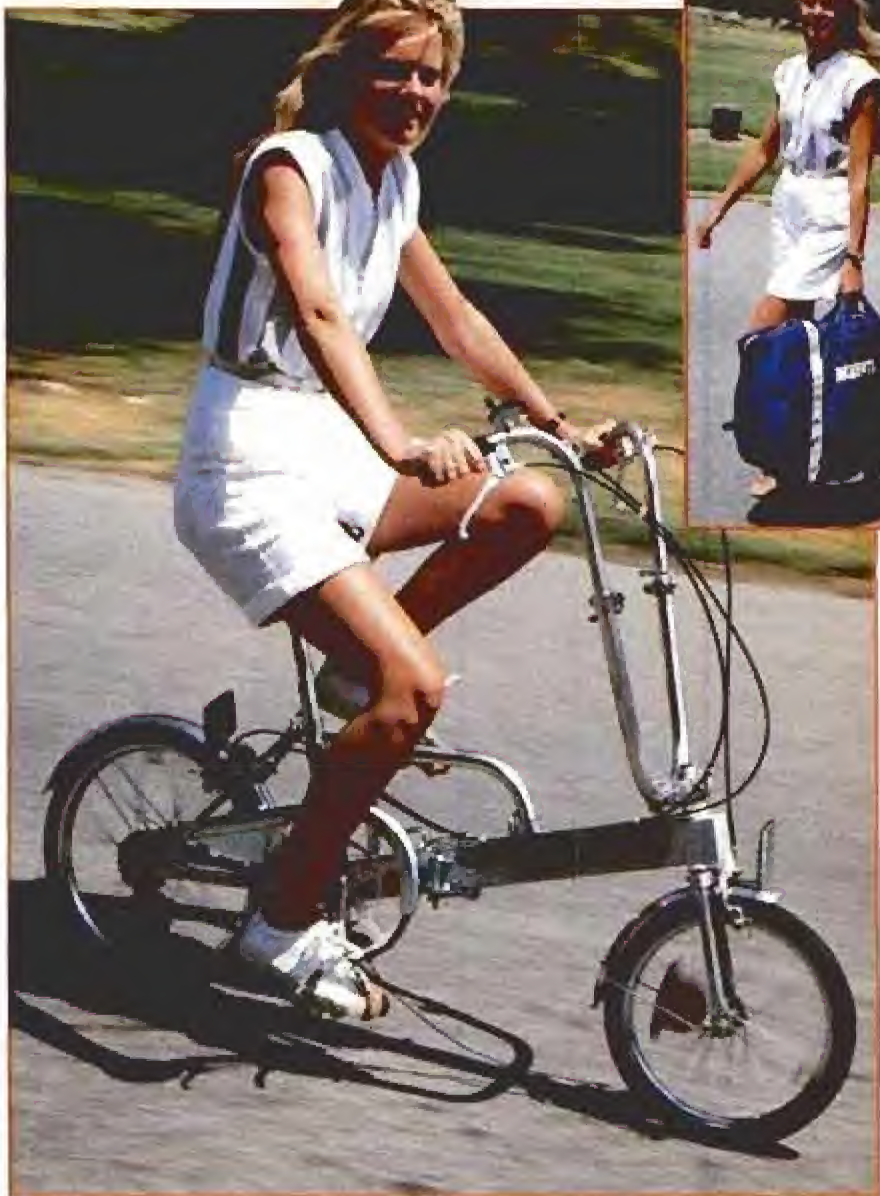
3



BIKING

Advances and accessories are adding more variety to pedal-power action.

Speedy lightweights from Univega are the men's \$300 Sportour and women's \$270 Viva-Sport (left). The 25-pound \$395 Bickerton Portable folds to fit carrying bag (right). The \$300 Veltec Pacer 2000H handle-bar meter monitors the rate of a rider's heartbeat, distance pedaled in miles or kilometers, speed and elapsed time.



A look at today's improved bikes and gear tells why the sport continues to grow. And a preview of the pedal-powered streamliners may be a forecast for the budget transportation of tomorrow.

Specialty machines for touring, for speed, for commuting, for trails and mountains, for bicycle motocross, for kids, and just for cruising are all being developed. Some bike builders believe new streamlining can lower the wind resistance of that major cause of drag—the rider—and are



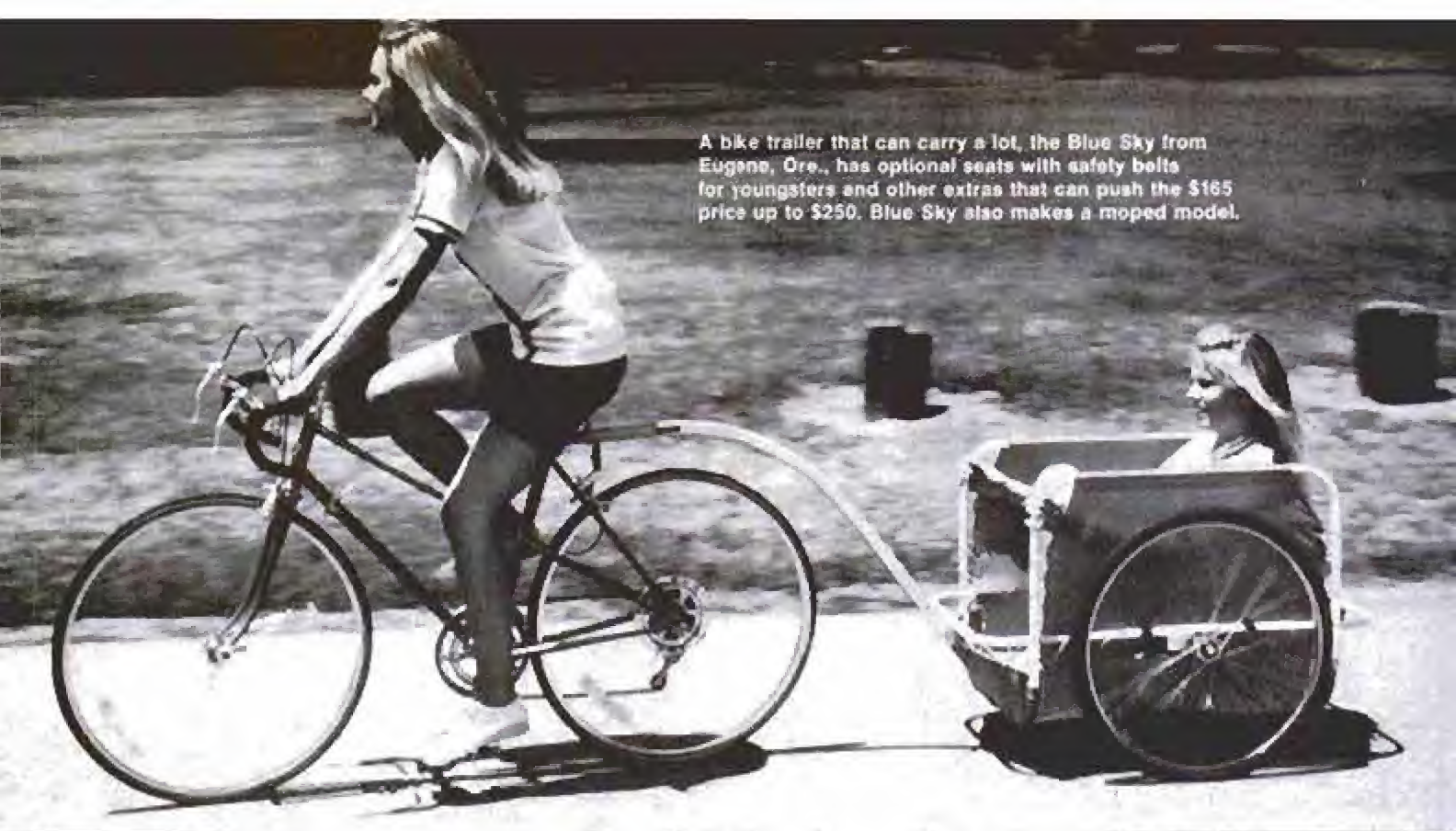
1 Mounted on the \$12.75 Rhode Rack Ultra rear carrier are Velocipac rear carrier bags, \$56.

2 The Hanna Pro Helmet, \$38, is recommended for BMX biking.

3 Zefal Hp tire pump, for \$12.75, is designed for the high pressures of bicycle tires.

4 Velocipac Bar bag, \$32, mounts on the center bar out of the way, but convenient for the rider.

5 Cannondale Cycling Gloves, \$15, have padded palms of leather.



A bike trailer that can carry a lot, the Blue Sky from Eugene, Ore., has optional seats with safety belts for youngsters and other extras that can push the \$165 price up to \$250. Blue Sky also makes a moped model.

designing special enclosures. Bikes can now top the legal speed limit for cars, with engineer Al Voight's Huff-y Vector tricycle recording 56.66 mph over a short course, and covering 36.94 miles in one hour. Huff-y, America's largest bicycle manufacturer, considers the Vector a prototype of commuting models for the future. A 15-speed Wind model is cur-

rently in production, and Huff-y is developing an Aerowind model with aerodynamic improvements.

Folding, take-apart and collapsible cycles stow in a closet, car trunk, boat or plane. The lighter the bike, the higher the price: You can get a

Shimano claims that its new cluster gear and rear hub gives smoother, easier shifts.



BICYCLE BUILT FOR ONE—OR TWO

There's a bicycle manufacturer in Oakland, Calif., turning out not only old-fashioned high wheelers, but also a brand-new type of bike, the convertible tandem.

Two bicycle enthusiasts, Mel Barron and Diana Hoffman, founded Rideable

Bicycle Replicas Inc. in 1975 to reproduce copies of 19th-century high wheelers. Then in 1981, Mel designed and patented the convertible tandem, which should be in production by the time you read this.

The convertible tandem promises to fill a need. If you've ever owned a conven-



40-pound foldup for about \$150, but a neat, 23-pound Pocket Bike goes for \$1,000.

Today's cyclists have specific demands and a number of specialized bikes are the result. Junior racing, off-road travel, distance runs and short shopping trips all rate special machines.

BMX bikes are used by youngsters for the pedal-power equivalent of dirt-track motocross. From a starting grid about 10 feet high, the track narrows into a series of jumps and bumps, straightaways and banked-berm turns that challenge the riders over a quarter-mile course. Offshoots from BMX include events down rugged hills on "thrasher" bikes and acrobatic rides on bikes called "tricksters."

Kids who don't graduate to mopeds often try mountain bikes—light, balloon-tired, trail-rider specials with high crank-to-ground clearance for off-road backpackers. A tamer version, also with conventional handlebars, is the 'round-town cruiser. And for distance pedaling, there are the lightweight, multigear tourers, cousins of the racing machines.

Helmets, bags, speed-distance-heartbeat monitors are some modern refinements. Over a dozen trailers are on the market and assorted improvements in gears and gadgets are available.—*Bill McKeown*



CYCLES OLD AND NEW

Step on the little bracket above the back wheel, swing up quickly, and you're off and riding on the high wheeler from Rideable Bicycle Replicas. Lie down in the cockpit of Huff's Vector tricycle, available by mail order from Early Winters Ltd., 110 Prefontaine Pl. S., Seattle, Wash. 98104, and for the cost of a sports car you can pedal a try at a new speed record. The rig is called the world's fastest human-powered vehicle. In trial runs, the futuristic cycle has been timed unofficially at nearly 60 mph.

Penny-Farthing replica (left), with 48-inch front wheel, costs only twice the 1885 price of \$315. Huff's Vector (below), from Early Winters Ltd., is \$10,000.



tional tandem, you know that riding one can be lots of fun *when and if* you find a partner. But partners aren't always available, so most tandem bikes tend to spend long periods gathering dust.

Rideable's convertible tandem, though, gives you a choice. Any time you can't talk someone into going for a spin, simply remove the tandem's center section and go biking alone.

The removable center section contains the forward seat, sprocket, and handlebars. In roughly two minutes, using only a screwdriver and pliers, anyone can pull out this center section, reconnect the front and rear halves, and ride off into the sunset.

You convert the gear mechanisms from tandem to single mode by undoing one chain link, removing the forward chain, unscrewing a short length of rear brake cable, and releasing two crank/thumb-screw pads on the frame. You then reat-

(Please turn to page 156)

A special center section on Rideable's folding bicycle can accommodate a seat, handlebars and crank (left) to easily convert a two-wheeler for one into a tandem (right),





Detroit shifts gears

Last-minute changes and eleventh-hour decisions have scrambled Detroit's traditional introduction dates.

Remember when the traditional new-car introduction was a *Big Event* every autumn? What will the new cars look like? What new engines and features will they have? Dealers covered their windows a few days before, buyers and tire-kickers lined up outside in anticipation, and a fortunate few drove one home that day to become first on their blocks.

For magazine auto writers, summer in Detroit became an annual orgy of "long lead" previews, when the manufacturers rolled out prototypes behind their proving-ground walls for test driving and photography. Because it takes about three months to get a magazine story into print, the idea was to get introductory articles in fall-issue magazines to coincide with the public introduction. Of course, the writers and editors were honor-bound not to reveal juicy details or publish authorized photos until the official—usually September—"release" date.

Imports use different routine

The imports, on the other hand, have pretty much ignored this Detroit tradition. They begin design and development of new products whenever a need is recognized and resources are available, and launch them whenever they're ready. If that happens to be in the middle of a model year, so much the better. That way, their press coverage doesn't get buried under the domestic new-model news.

In recent years, under intense scrutiny from all sides and heavy pressure to meet the import competition, Detroit has been moving more and more in that direction. Mid-year introductions of major new products (GM's X- and J-cars, Ford's EXP/LN-7) have become commonplace, and some of the old cloak-and-dagger secrecy has been replaced by surprising candor about new-product programs. Twice in the last two years, Chrysler has shown prototypes and styling models of its future products to selected groups of dealers, press and government people.

At this summer's magazine shows, Ford offered demonstration

(Please turn to page 168)

WHEN THE '82 CARS WILL BE IN THE SHOWROOMS

GENERAL MOTORS

September
1981

New: Chevy/GMC rwd* mini pickup.

Carryover: Intermediate sedans: Malibu, Monte Carlo, Cutlass Supreme, Grand Prix, Regal, Bonneville (rwd G-cars). Full-size sedans: LeSabre, Electra, Impala, Caprice (rwd B-cars).

October
1981

New: Corvette.

November
1981

New: Chevy Celebrity, Pontiac A-6000, Olds Cutlass Ciera (fwd† A-cars).

Carryover: Phoenix, Citation, Skylark, Omega (X-cars); Chevrolet, Pontiac T-1000 (T-cars); Cavalier, J-2000, Cimarron (J-cars).

December
1981

New: Camaro/Firebird (F-cars—downsized, still rwd).

February
1982

New: Olds and Buick versions of J-cars (to be named). Impala/Caprice line discontinued.

FORD

September
1981

New: Continental (downsized, still rwd).

Carryover: Escort/Lynx, Mustang/Capri, Futura/Zephyr, EXP/LN7, Thunderbird/Cougar XR-7, Lincoln, Mark VI, LTD, Marquis.

November
1981

New: Granada/Cougar wagons (still rwd).

April
1982

New: Ranger mini pickup (rwd).

CHRYSLER

September
1981

New: Super Ks—LeBaron/Dodge 400 (fwd); New Yorker (downsized, still rwd).

Carryover: Colt/Champ, Omni/Horizon, TC3/024, Challenger/Sapporo, Mirada, Cordoba, Imperial, Gran Fury, Diplomat.

April
1982

New: LeBaron convertible (fwd), Omni/Horizon-based mini pickup (fwd).

AMERICAN MOTORS

September
1981

Carryover: Concord, Spirit, Eagle, SX-4, Jeep CJ-5, CJ-7, Scrambler, Wagoneer, Cherokee, Renault LeCar, 18i.

*rwd: rear-wheel drive
†fwd: front-wheel drive

Although it's still playing a catch-up game, Ford has delivered some interesting surprises for '82 and done a very good job of making its carryover hardware more appealing and competitive.

Perhaps the most interesting car in this year's lineup is the Continental, built on what would seem to be a humble platform, that of the Cougar XR-7. And the Cougar platform was, in turn, based on a stretched version of the even more humble Fairmont/Zephyr "Fox" platform. As cut-and-paste as this may sound, the '82 Continental nevertheless is every inch a luxury car, truly worthy of wearing the esteemed Lincoln badge.

But, more on the Lincoln Continental later. In addition to this luxury car, Ford has introduced a five-door hatchback version of the popular front-wheel-drive Escort/Lynx and a Granada/Cougar station wagon for '82.

A new 3.8-liter V6 engine is optional in Granada/Cougar and T-Bird/XR-7, and a new lockup torque converter becomes standard in most rear-drive models with the 3.3-liter straight Six and the 4.2-liter V8.

Standard fuel tank capacities of

For '82, Mustang can be had with an optional 5.0-liter V8, which gives it super performance. Coupled with TRX handling package, this buzz bomb can corner, as well as accelerate.

many models have been increased, and there's an optional 20-gallon extended-range tank for Fairmont/Zephyr and Granada/Cougar. With their fuel tanks redesigned and re-located to the area between the luggage compartment and the rear seat, these cars also get a more usefully shaped deepwell trunk, replacing the

The '82 Fords

Dearborn serves up
a surprising new
Continental and a
lightning-quick Mustang.

by Gary Witzenburg
DETROIT AUTO EDITOR

previous shallow, flat-floor design.

There's a new Tripminder option for LTD/Marquis and T-Bird/XR-7 that helps plan fuel stops, predicts arrival times and monitors fuel economy.

Cars with AM or AM/FM monaural radios now get two speakers instead of one. A flash-to-pass feature is added to the column-mounted high/low beam switch in most models, analog clocks are upgraded with a more accurate quartz-crystal

time base, and most gas caps are now tethered to prevent losing them.

Unfortunately, the LTD/Marquis 5.8-liter V8 engine has been discontinued. This means that the heaviest-duty towing package available on these (or any Ford Motor Co.) cars is now a Class II setup, good for trailers up to 3,500 pounds.

Besides the new wagon, which has a 79.5-cu.-ft. cargo capacity and a handy (optional) lift-up window in the tailgate, changes to the Granada/Cougar line include replacement of the 4.2-liter V8 with the new 3.8-liter V6 as optional engine and discontinuation of the base, four-cylinder Cougar.

Ford's Fairmont line is consolidated to a single Futura series in two-door sedan, four-door sedan and two-door sport coupe body styles, while the corresponding Mercury Zephyr now offers only four-door and Z-7 two-door coupe variations.

Exciting news for Mustang and Capri buyers is a really powerful new 5.0-liter V8 engine (teamed with a four-speed manual transmission) that gives excellent (8.0-sec., 0 to 60-mph) performance, thanks to a special camshaft, large-venturi carburetor and low-restriction intake and exhaust systems.

This new Mustang reminds us of the old muscle car days—but even better, because this car really handles. The TRX handling package, which was available last year, can



now be used to the fullest, due to the increased power on hand.

Introduced as mid-year models, Ford's EXP and Mercury LN-7 get a higher performance 90-hp engine option. The basic 1.6-liter Four is still the same, but has been tweaked to yield 20 more horsepower. At first, this engine will come only with an automatic transmission, but will soon be available with a close-ratio, four-speed gearbox.

This close-ratio box, as well as a much improved handling package, will also be available in Escort/Lynx vehicles.

Lincoln Continental

The Continental measures 201.2 inches long on a 108.5-in. wheelbase, about an inch longer than the Cougar XR-7, four inches longer than the compact Zephyr and 15 inches shorter than the two-door Mark VI. It comes in a single four-door body style in Standard, Signature Series or Givenchy Designer Series trim and is powered by your choice of a 5.0-liter V8 or an all-new, lightweight, 3.8-liter V6 coupled to an improved four-speed overdrive automatic transmission with a fuel-saving, lockup torque converter that operates in all four gears. Base curb

weight is 3,555 pounds—fairly svelte by luxury-car standards. Projected EPA-rated fuel economy (final numbers weren't in at press time) is 16 mpg city, 24 mpg highway with the V8; 18 city, 26 highway with the V6.

Most surprising is the job the chassis engineers have done to refine the competent, but unremarkable, Fox-platform suspension to give a fairly Lincolnesque feather-pillow ride, without the usual barge-like, unresponsive, marshmallow handling.

Extra-soft springing and increased ride travel do result in a lot of body roll when the car is pushed hard through a corner, but the variable-ratio power rack-and-pinion steering produces relatively quick and precise response and a far less numbing feel than that of any past Ford product of this size and above in memory. It's no sports car, of course, and no match for the typical agile-handling European luxury car, but it's also less harsh and stiff-kneed—and that is what most American luxury-car buyers still prefer.

Key to the Continental's exceptional ride/handling compromise is a combination of clever and cost-is-no-object engineering. For one thing, both the modified (separate,

inboard coil springs) MacPherson-strut front and four-bar-link, coil-spring rear suspensions utilize low-friction, gas-pressurized shock absorbers that soften minor bumps and don't heat up and fade in rough going.

The front lower control arms are of a new multipiece forged design with integral, low-friction plastic ball joints and larger, softer rear bushings to ease impact harshness. Voided, elliptical, tri-rate rear suspension control-arm bushings give good impact isolation in the longitudinal direction, while preserving vertical load-carrying capacity and lateral cornering-load rigidity.

There are also ride-smoothing rubber sleeve dampers inside the rear springs and thick rubber isolators between them and the body. Four-wheel, hydraulically boosted disc brakes provide excellent stopping power and fade resistance; and unique P205/75R15 self-sealing tires, on forged aluminum wheels, have low rolling resistance to aid fuel economy and an aggressive, wrap-around, all-weather tread pattern.

The new 3.8-liter V6 engine was designed to give the performance of a small V8 and the fuel economy of a Six at the weight of a four-cylinder.

Downsized Continental is built on a Cougar platform. Among the Continental's many surprises is that it handles extremely well for this type of car. V6 is standard, with V8 optional.



Putting out about 112 hp, it weighs only 311 pounds—four more than Ford's 2.3-liter four, 130 less than the 4.2-liter V8 and 64 less than the same-displacement Buick V6, according to Ford.

Its horsepower-to-weight ratio is better than any other Ford engine (except the high-performance 1.6-liter Escort/Lynx Four) and most others in the domestic industry.

Its cylinder heads, intake manifold, pistons, front cover, water pump, oil pump and accessory brackets are aluminum, its block is thin-wall cast iron, its rocker-arm

covers are lightweight plastic, its accessories are run by a single, serpentine drive belt, and its cast, nodular-iron crankshaft has offset pins for even, 120-degree firing impulses.

Through a computerized process called "engine mapping," its calibrations are set for optimum economy and (unless there's a last-minute

change) should not need electronic engine controls to meet 1982 emissions standards—except in California, where microprocessor air/fuel ratio control and electronic knock detection are used. All this adds up to an engine that's smoothly adequate in a well-equipped Continental, though the alternative 5.0-liter V8 gives better performance at a one- or two-mpg real-world economy penalty.

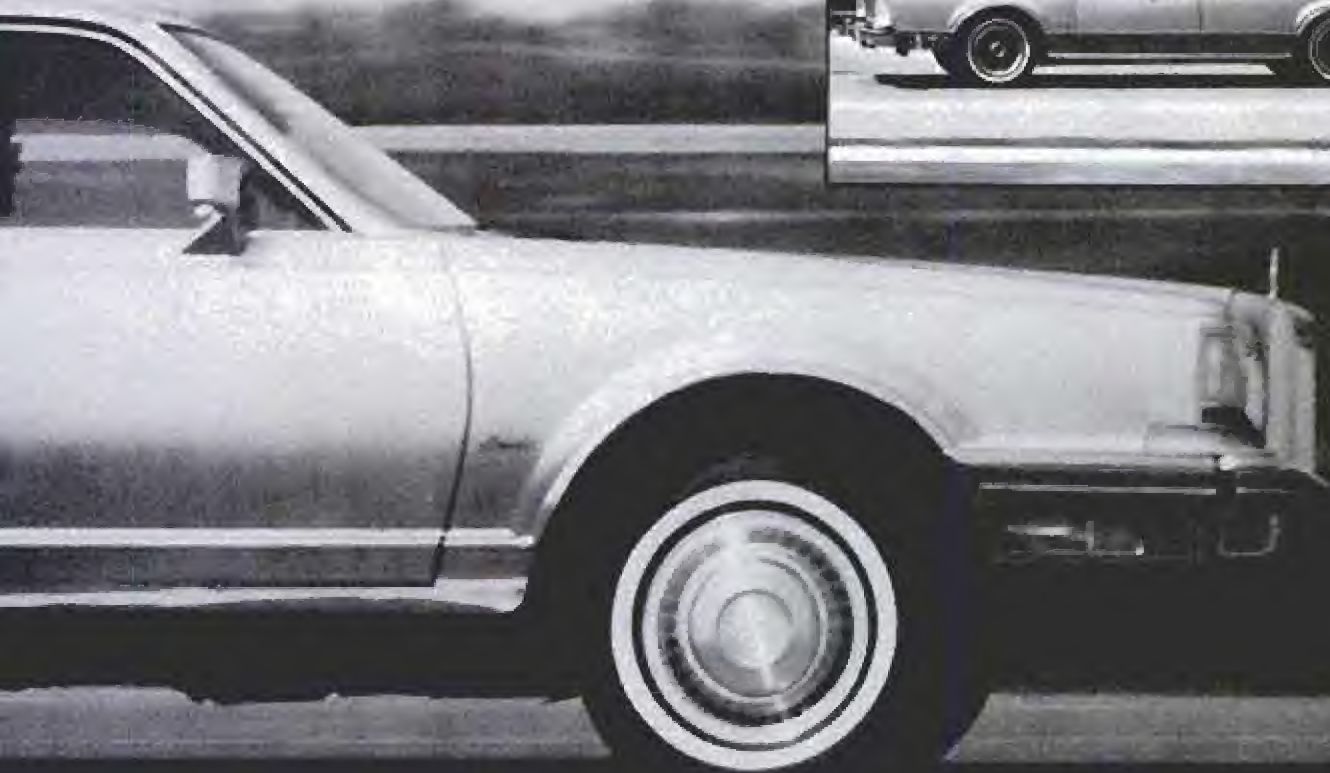
It's no surprise that the Continental is fully equipped inside, with plenty of head, hip and shoulder

(Please turn to page 168)

Ford EXP (right) gets a high-performance version of its 1.6-liter, four-cylinder engine. '82 Ford Escort (GLX, below) and Mercury Lynx come as five-door hatchbacks.



Cougar wagon (below) has a standard 3.3-liter V6 and optional 3.8-liter V6. No V8 is offered. The Lincoln Town Car (bottom) comes with 5.0-liter engine only.



Airborne from the ground up

In contrast to costly, complicated defense technology, the mating of two proven systems could add the dimension of a 'flying start' to combat aircraft.

Whether it's a barroom brawl or the ultimate, unthinkable nuclear conflict, the idea behind making the first move — the first strike—has always been the same: Wipe out the opposition's ability to retaliate. The principle has no better illustration than the case of one side's sending its air forces after the other side's airfields. You may have the best airplanes and military pilots in the world, but if they can't take off, kiss air superiority good-bye.

Overcoming a preemptive air strike has always been on the minds of the U.S. Air Force's strategists, and one system now being readied for testing represents a possible solution in the form of a unique combination of existing technol-

Bell Aerospace will carry out wind-tunnel tests on a model AATS platform supporting a 1/10-scale F-4 fighter mock-up (bor-

rowed from the Navy). The tethered system will be studied to assess its overall stability in an airstream.



ogies. The idea, called Alternate Aircraft Takeoff System and referred to by the inevitable acronym AATS, originated at the USAF's Flight Dynamics Laboratory at Wright-Patterson Air Force Base near Dayton, Ohio. It calls for the development of a ground-effect machine, popularly known as a "hovercraft," to serve as a support platform enabling combat aircraft to take off from bombed or otherwise damaged runways.

The unmanned hover platform would use its own power for ground-effect ascension only; the aircraft's jet engine or engines would accelerate both the plane and AATS to takeoff speeds. Upon actual takeoff, the aircraft's wheels would leave the wells built into the hover

platform and drogue parachutes would deploy automatically to slow and eventually halt the AATS for retrieval.

Capt. Richard Almassy, project officer for AATS at Wright-Patterson, told PM that, as currently envisioned, an operational system would use a platform with conventional hovercraft-type pleated rubber skirting levitated by a Pratt and Whitney PT-6 (small utility aircraft) turbine engine driving a ducted fan. This, Almassy says, could accommodate a combat-ready F-15 fighter (over 45,000 pounds gross weight) and enable it to achieve takeoff speeds over—not exactly "on"—runways that are bomb-cratered.

Also implied, if the system works,

are possible takeoffs over unprepared terrain, sheltered waters, or even a "mixed-media" takeoff—a first for any aircraft.

The big question to be answered in scale-model, wind-tunnel tests being readied by Bell Aerospace, as USAF's contractor, concerns the overall stability of the mated aircraft/hovercraft system at the necessary speeds. If this can be determined with 1/10-scale models in the tunnel, a full-size prototype could be in test by 1983.

And if full-scale systems are feasible, why not a hybrid aircraft with its hover capability built in? In a "stealth" configuration, capable of takeoffs from anywhere, it could rewrite the strategy books.

—Robin Nelson



Any gripes voiced by Starlet owners are overshadowed by the praises. Really—what's to complain about?

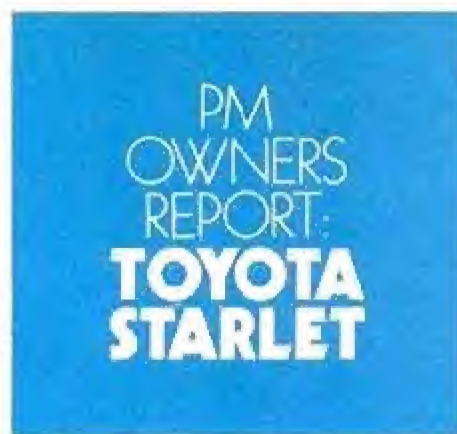
The Toyota Starlet delivers 34.7 mpg in town, according to our owner survey, and 42.5 mpg on the highway. That's a record in our book, as well as the EPA's.

Of course, real-world fuel economy didn't measure up to the EPA's 39/54 mpg, but then, it never does. Yet most Starlet owners who purchased their cars for economy—and that's a cool 91.1 percent—weren't shedding any tears for the oil sheiks.

And, yes, if you look at the summary at the end of this story, you'll see that 14.2 percent of our respondents said they'd appreciate mpg figures to match those projected by the EPA. But face it, friends, that's like the Hunt brothers grumbling



Agile handling and quick responses got rave reviews from most Starlet owners.



because they have to lug all those heavy canvas bags to the bank.

Nor could our owners fault the Starlet on mechanical grounds. In nearly two million miles, only 17.8 percent of the owners surveyed had even glimpsed the inside of the dealer's back shop. The rest just filled the tank with unleaded at 400-mile intervals and kept their right foot on the gas pedal.

The impression we got from owner questionnaires was that this is an extraordinarily good car, doing just what its buyers expected—or perhaps a bit more.

From an Illinois postal employee: "This is not a luxury car. It's basic, no-frills transportation. I'm getting excellent gas mileage—up to 44 mpg on the road—and have needed no service at all in 8,300

miles. The Starlet is superior to domestic cars in workmanship, paint quality, panel alignment, and, most of all, price. I have no complaints. The Starlet serves its purpose perfectly."

A sporting-goods manager from Rhode Island told us: "Nothing's out of place, and nothing's taken me back to the dealer in 6,500 miles. Dependability seems the result of proper engineering and quality control. Who has time, money, and patience for repairs? Ultradependability seems to be a long-term Toyota sales scheme. Mileage ranks very close to dependability on my list of likes—and so



Despite its spartan interior, owners found Starlet to be surprisingly comfortable.

does price. I almost forgot price, but with a car this good that's also one of the lowest priced on the market, how can I go wrong?"

BY MICHAEL LAMM WEST COAST EDITOR

Toyota's Starlet stars in fuel economy, but some owners just never get enough!

Owners praised the excellent headroom.

Some owners want cargo area covered.



PM photos: Charlie Lamm

A Texas military officer: "We have five drivers in the family and only three cars—the Starlet, a VW Beetle and a Cadillac. Everyone wants to drive the Starlet, and we'd love to replace the Beetle with a second one [Starlet]. Our family is taller than average, yet there's room for two weeks of groceries plus three or four kids in the back. Great headroom, too, and lots of pep from the engine."

A Delaware chemical supervisor: "I really love the car. I owned a VW Rabbit previously and, in my opinion, the Starlet is superior. It's totally troublefree and costs less to buy and operate. On a recent business trip to Georgia, I averaged 47.7 mpg under excellent road conditions, but get about 42 to 45 in normal highway driving. I have no complaints and have never needed service, though I did get a flat tire once."

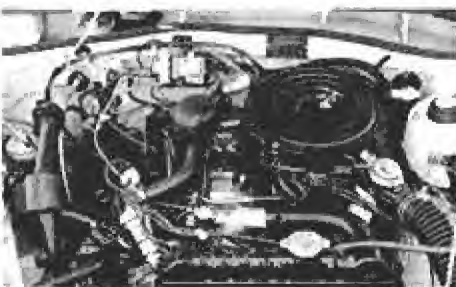
A Texas engineer was one of the few owners who did need dealer service. "I had a loose defroster duct and noisy speedometer cable. The dealer repaired these under warranty and also adjusted the idle at the same time. The car could use additional sound insulation, because it's noisy and buzzy on the freeway. That would add weight, however, which would cut gas mileage. For great gas mileage, features and overall engineering at an affordable price, the Starlet is one whale of a car."

An Illinois nurse was a member of the

minority that complained about fuel mileage. "I've been disappointed in that regard," she told us, "and am getting 28 to 30 mpg instead of 39 to 54. I'd also like a light to show when the manual choke is pulled out, because I sometimes forget to push it back in, and that wastes gas."

"While I'm wishing, I'd like smaller rear wheelwells so there'd be more luggage space, plus a utility shelf under the glovebox. And a shade over the luggage area to hide what's stored back there. And a rear wiper, which I didn't get, and a sunroof, which I can't get."

A New Mexico soil scientist: "We were made to feel very welcome by the dealer, and the salesman didn't try to pressure us



Diminutive 1.3-liter Four sips gas at an economical rate of 42.5 miles to the gallon.

into buying a more expensive Toyota. Now that I've put 7,500 miles on the Starlet, I appreciate the gas mileage and the

(Please turn to page 162)

Starlet in the spotlight

Toyota delayed the Starlet's American debut until 1981, but the thrifty little three-door had already played to European audiences for a couple of seasons. And its major mechanicals can claim 15 years of dramatic training. So when the Starlet hit the boards here, she arrived with a stage-tested script and considerable off-Broadway experience.

Nothing seems to succeed like traditional lines, which, in the Starlet's case, complement conventional engineering: a front-mounted 1290-cc Four driving the rear wheels; MacPherson struts fore, four-link coils aft; a mere 1,810 pounds of weight; and ample space for two adults up front plus two kids or 11 cu. ft. of cargo in the rear area.

At a base price just above \$5,000, the Starlet is not the least expensive actress in Toyota's stable of stars. She is, though, the most fuel-efficient gasoline-powered car currently sold in this country, with an impressive EPA billing of 39 mpg city and 54 mpg highway.

The Starlet comes only one way: three-door hatchback in one trim level. But standard equipment includes tachometer, trip odometer, well-bolstered bucket seats, fold-down rear seat, carpeting, five-speed manual transmission with an overdrive, front disc brakes and rack-and-pinion steering.

With such an array of features, it's no wonder the Starlet receives ovations wherever she goes.

A NATIONWIDE SURVEY BASED ON 1,884,519 OWNER-DRIVEN MILES

Owners feel that the airconditioning controls need some improvement.

The large cargo area can handle lots of groceries or enough luggage for a long trip (right). Unlike most economy cars, Starlet has rear-wheel drive, not fwd. Some owners would prefer fwd for better traction in snow and inclement weather.



The durable engine and reliable drive train require little service.



Oh, to be a traffic cop for a day!

by Wade Hoyt

You shake your fist and honk your horn at these Interstate bozos. Don't you wish you could give them a ticket?

Take a drive down any Interstate in the country and you'll see the usual shenanigans: people backing up for missed exits; people coming to a full stop in the acceleration lane, then pulling out into the path of oncoming traffic at a 45° angle; people pulling homemade trailers that handle about as well as a paper cup in a typhoon.

Naturally, the only troopers you see are manning their radar units, ready to give speeding tickets to vacationers, businessmen, truckers and other generally law-abiding citizens who are driving attentively, but slightly over the speed limit. It might lead you to wonder: If I were a traffic cop for a day, who'd get the tickets, and who'd get off?

It's a fact of life that a police officer cannot ticket every law breaker that he sees—if he did, he'd never get more than a half mile from the station house!

So he must pick and choose from a garden blooming with violations, ticketing those that are especially dangerous, or are easy to make stick in court, or are his pet peeves, or—in many cases—are the target of a special campaign against speeding.

Here are the folks I'd bust. See if you agree with me.

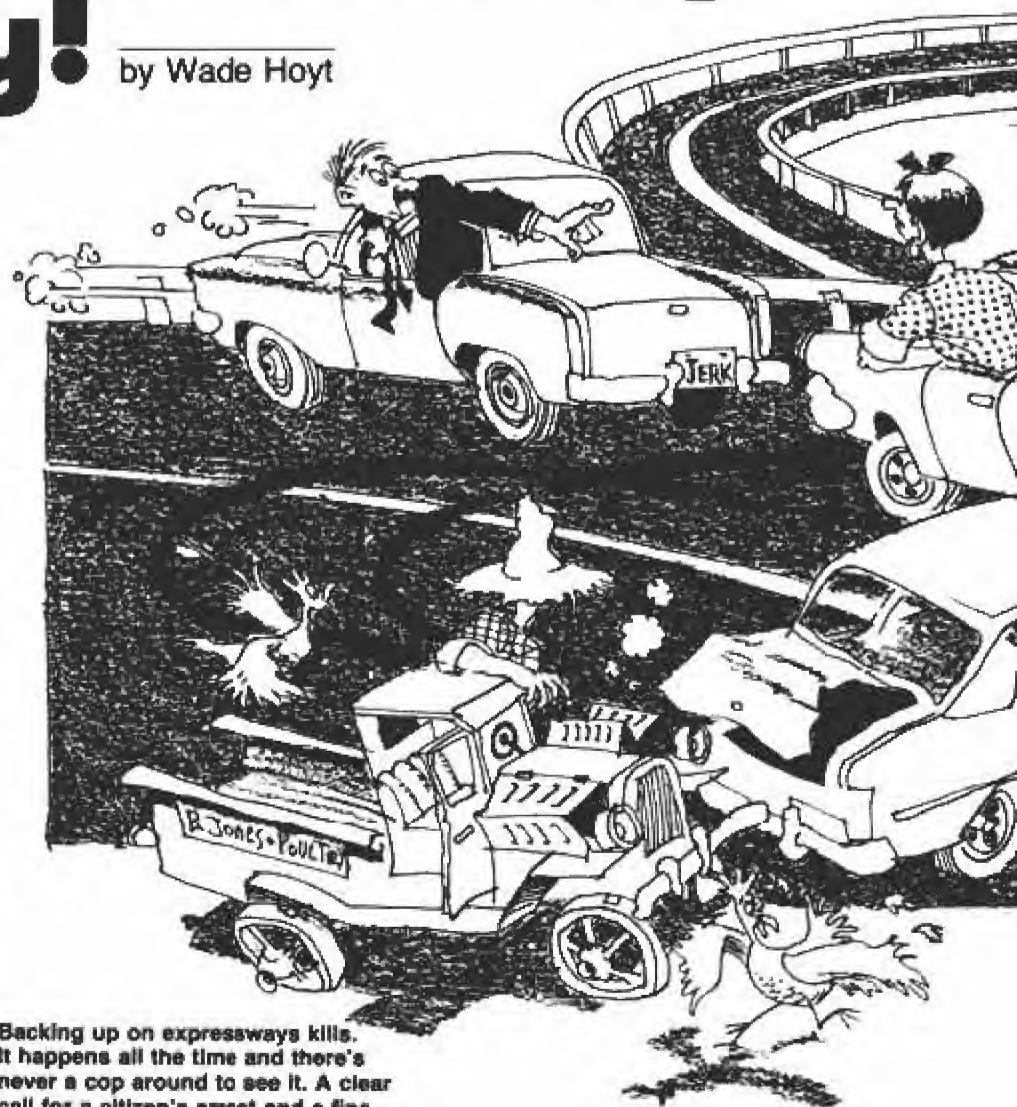
Things I'd give tickets for

■ **Failure to dim bright lights**—Hey! Give me a break. This guy drives me nuts! It's usually a suburban cowboy in a pickup and he's running with enough auxiliary halogens to light up Chicago. Not only does he want to see the road, but every blade of grass on the shoulder, as well. In the process, he gives everybody in front of him severe radiation burns.

These superbright



In your mirror he's big as a house and blistering you with a million candlepower. Here's a ticket; shut the lights.



Backing up on expressways kills. It happens all the time and there's never a cop around to see it. A clear call for a citizen's arrest and a fine.

lights have their purpose. But they're not for a detailed examination of your retinas. I'd write him up in a second. It's not only a nuisance,

but a serious menace on the road.

■ **Engine running in an unattended car**—This is not only dangerous and an open invitation to car theft, but it also makes OPEC happy by wasting lots of gas. I've seen parked cars running with only children inside and the parents off shopping! Maybe they should test your I.Q. along with your eyesight down at the Motor Vehicle Bureau!

■ **Driving with snow on the car**—Do you know anybody who's guilty of this? You usually see this squid in the early morning. He looks like he just drove through a snowbank. He's cleared a tiny section of the windshield and let the rest of the snow cling to the car. The idea here is that he'll let the wind blow the car clean, not realizing that there are icy chunks along with that fluffy white stuff blowing away behind him. And the icy stuff decides to fly off just when he cuts you off. And he doesn't even know he has cut you off



because of all the snow on the windows.

Nice guy. See you in traffic court, buddy. You're dangerous!

■ **Failure to keep right (except to pass)**—This self-righteous, Drive-55er clogs up the fast lane and forces other drivers to commit the dangerous or (in some states) illegal act of passing on the right. This can also cause other nuts to "get even" by cutting off the snail—another dangerous and ticketable offense.

■ **Taking up two parking spaces**—I know the exercise is good for me, but

sometimes I'd rather not park two blocks away—at least not because of a rude, thoughtless driver.

There's no law against this on the books, so even a cop won't do you much good with this one. But, I'd love to give him a fine and 30 days hard labor in a busy parking lot.

■ **Driving without lights after dusk**—This is another one the I.Q. test might solve. If it's too dark to read the instruments, you'd think a person would be able to figure out that it was time to turn on the lights.

■ **Operating an unsafe vehicle**—This

includes all the rambling wrecks with bald, underinflated tires, wobbly wheels, nonexistent brakes, dragging exhausts, missing or badly aimed headlights, and so on.

■ **Backing up on expressways**—These people have got to be out to lunch. How can anybody be so ignorant as to risk a massive pile-up by backing up to a missed exit? But you see it all the time, and it's scary. And there's never a cop around when it's happening. They're too busy playing space wars with radar guns.

This should be a capital offense. It often is for the other guy.

■ **Opening doors into traffic**—Another suicide mission that can involve innocent passersby.

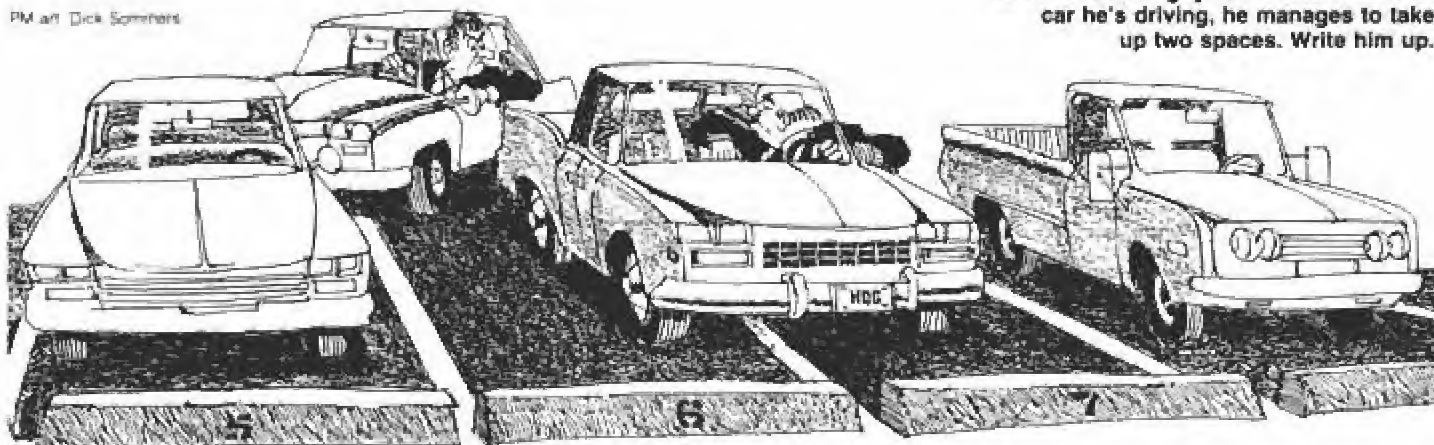
■ **Unnecessary horn blowing**—This annoyance is illegal in New York City, but the law is seldom enforced. Horns are for emergencies. They are not substitutes for doorbells, nor are they an acceptable way of signaling displeasure or frustration. The biggest problem with abusive horn-blowing is that, like the boy who cried "wolf," you may find no one listens when you really mean it. After two convictions under this statute, the offender's car should be equipped with a horn from a diesel locomotive. On the dashboard. Facing the driver.

■ **Driving too fast for conditions**—Even Mario Andretti has to slow down for rain, snow, fog, and ice. So why not you and me? Just because you didn't crash in the last half mile doesn't mean you won't crash in the next half mile.

■ **Tailgating**—Tailgaters are usually dangerous, frustrated, unpredictable drivers. I always pull over and let them by. I'd rather have them in front of me, where I can see them.

■ **Hit and run, or dent and run**—Both

PM art Dick Sommers



The nerve of this guy. No matter what size car he's driving, he manages to take up two spaces. Write him up.



What does it take to push a broom over a car? Not much. But, apparently it's too much work for some people. This guy would much rather transfer the snow to your car.

of these acts come under the heading of "leaving the scene of an accident." This is a serious offense in all states, and the penalties can be equally severe, whether you've struck someone or scratched a paint job. This is to encourage you to face the music the first time around.

■ **Driving without seatbelts**—Like motorcycle helmets, auto seatbelts are for your own protection. Making you wear them may be a violation of your rights, but not wearing them only encourages timid lawmakers in Washington to violate your wallet by demanding expensive air bags on everything from buses to motorcycles.

There ought to be a law that we wear the seatbelts already in our cars, and thereby save many of the 1,000 lives lost in traffic accidents on our nation's roads every week.

■ **Kids standing up in a car**—This one is very dangerous, and the cops don't even bother with it. I've seen cars loaded to the roof with a half dozen kids pass by a police car, and the cop doesn't even give them a second glance. It's an accident waiting to happen.

Even if you don't have a collision, unbelted kids could get badly hurt. A panic stop or really fast evasive maneuver can send children bouncing all over the car.

I'd have no qualms about giving this offender a very stiff fine and putting points on the license, too.

■ **Pulling away from the curb without signaling**—I've been spooked and startled countless times by drivers

who pull away from the curb without signaling. Usually, the driver is facing me on the other side of the road parked along the curb. One moment he's just a "parked car" and the next, he's in the traffic flow—a potential head-on threat to you, especially if the road is a narrow suburban street, where traffic usually uses the middle of the street between the parked cars on either side. Some day, this bird is going to get you—and himself—if he's not ticketed now to change his sloppy behavior.

■ **Passing a bicycle recklessly**—This

often happens on two-lane roads when a driver is too thoughtless or too arrogant to slow down to the bicyclist's speed until the road is clear to pass.

Frustrating as it is, you should stay behind the bike on curves, hills, or when there's traffic coming the other way. A short, friendly toot of the horn from 100 feet away will get

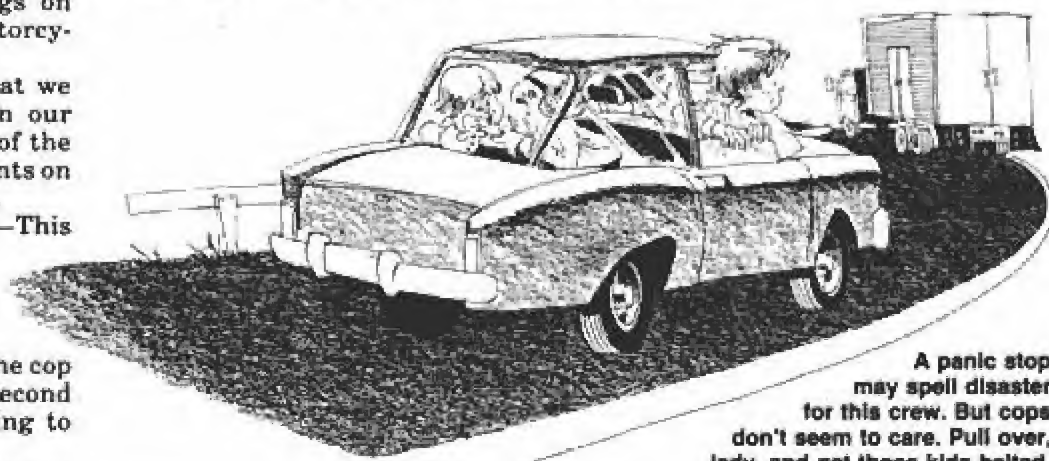
most bikers to move over onto the shoulder of the road (if there is one) so that you can get by. Don't sneak right up to him and lean on the horn!

■ **Driving too slow for conditions**—This just makes other drivers nuts and causes them to do crazy things. You're always safer when you go with the flow, neither too fast nor too slow for driving conditions.

■ **Driving under the influence**—The local police or highway patrol—even the CHiPs—can't spot every driver whose erratic lane changing, speeding up and slowing down indicate that they are driving under the influence of alcohol or drugs. When you spot these killers, there's not much you can do to get them off the road without taking the law into your own hands.

If you think that you're trailing an impaired driver, the best thing you can do is alert other drivers coming up behind you with hand signals or your flashers, but there's no way to alert oncoming traffic—the unsuspecting drivers who face a possible head-on. The wisest course of action is to pull off the road at the first opportunity and call your local police emergency number. Give the description, license number, location and direction the car is traveling.

We've done this several times and on one occasion, had the satisfaction of the highway police calling us at home an hour later to assure us that the driver was apprehended and off the road.



Those are the guys who drive me nuts, and the ones I'd ticket if I were a cop. What do you think? We'd like to know. If you'd like to ticket a certain type of driver, or some particular maneuver that's not covered by a law, let's hear about it.

Mail it to Popular Mechanics, Traffic Cop, 224 West 57th Street, New York, N.Y. 10019. **PM**

The wettest, wildest outboard

It's shaped like a bathtub, and hasn't been changed in 20 years. It has starred on television and can run while full of water. It's called a Flying Flivver, and would probably require half a ton of bricks aboard to sink it.

Four times a day, for many years, it has performed for thousands of spectators, as Corky, resident clown in the famous Cypress Gardens ski show, puts it through its paces at Winter Haven, Fla. Standard power is a 6-hp motor, which gives lively and economical performance, but for exhibition work at the Gardens it mounts a Johnson 25. Set up for racing, it has successfully handled mills of up to 50 hp and speeds as high as a startling 57 mph. For a TV show, builder Mike Osborn added a racing deck for his small son to drive.

PM photos: Jerry Imber, Cypress Gardens

Overall, the fiberglass hull is 8 feet, 2 inches long, with two built-in foam sponsons that give it extensive stability and flotation. Osborn Marine, 888 Lake Drive, Winter Haven, Fla. 33880, provides Flivvers in red, blue, yellow, green and white. The 56-inch beam aids the buoyancy chambers in making the Flivver almost unflippable. Spectators expect to see one kite over backward, but its design forgives rough treatment and makes it a good craft for kids, as well.

The price from Osborn is \$499. A standard model weighs 120 pounds, but Force Engineering in Sarasota, Fla., builders of the Stiletto catamaran, used Nomex honeycomb to cut one to an experimental 30 pounds. But at any poundage, the Flivver is a heavyweight in performance.

—Bill McKeown

Almost any boat can be capsized, but Corky-the-Clown's Cypress Gardens show routines have never managed to do it.



Rugged enough to run over sandbars, the boats performed the stunt for a TV show.



An experimental, lightweight model pulls a barefoot water skier; it can tow three or more on skis with a 25-horse outboard motor.



Even full of water, the Flying Flivver can power along with a high-mounted outboard, and bail itself out as the speed increases.



Customized with racing deck and cockpit for a young driver, the Flivver, with jacked-up motor, turns in a sizzling performance.

Put PM's kitchen organizer on your door

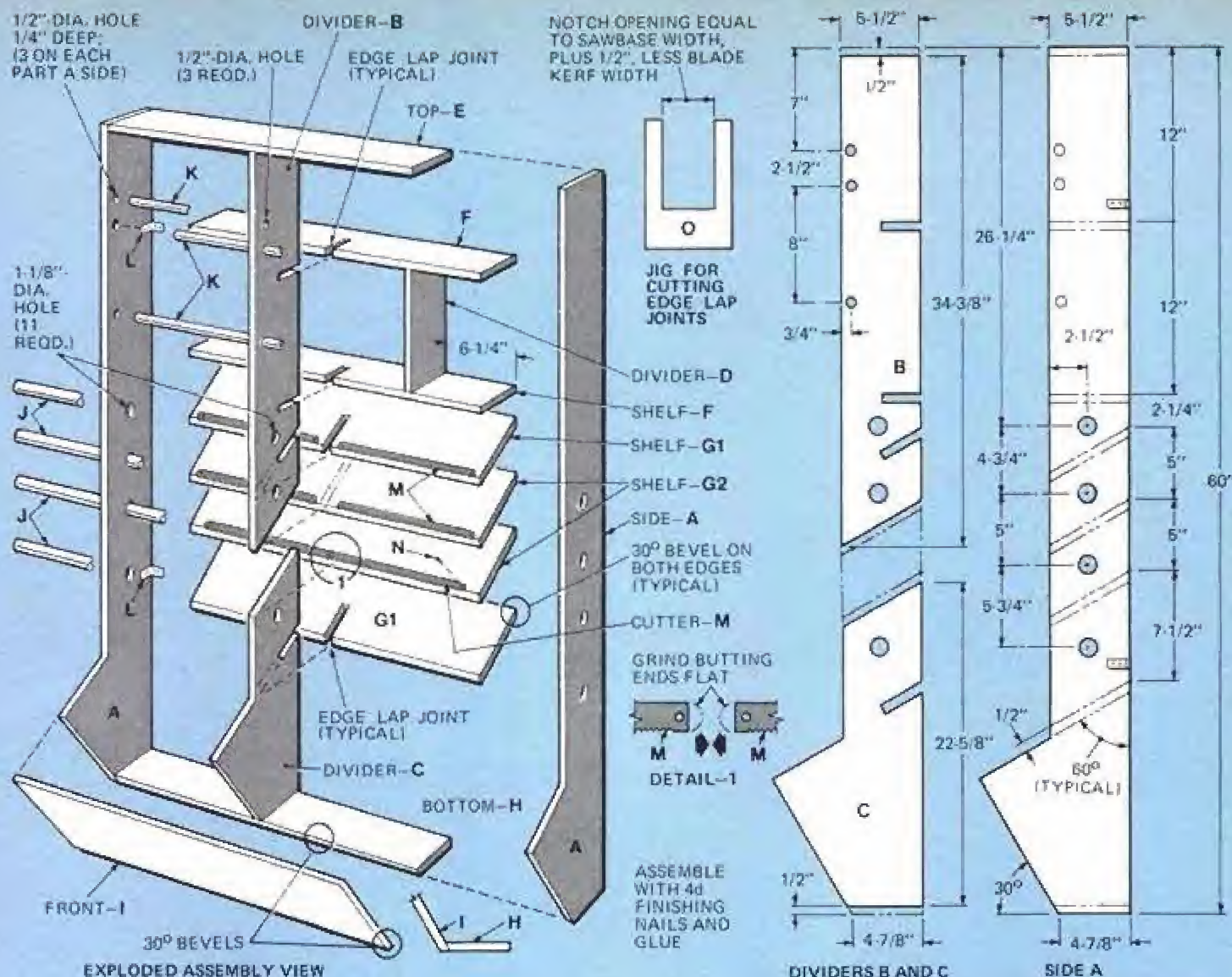
Well-planned storage keeps everyday items in one spot and out of sight when the door is closed.

Make this kitchen organizer and you'll find the whole family enjoying its conveniences. You can install it on the back of any door, such as the one leading to the basement, garage or pantry. It is so attractive, though, you may not want to hide it.

Designed by architect Lester Walker, the unit has received careful consideration for storing the most commonly used kitchen items. Toxic liquids are stored on the upper



PM's unique storage cabinet uses otherwise wasted space — the back side of the door to the basement. It corals in one spot those kitchen items used everyday — aluminum foil, wax paper, paper towels, deli containers, bags, cleaning supplies and more.



shelves out of reach of children; lower bins may contain paper cups, napkins and anything else children use regularly.

Perhaps the neatest features are the wrapping dispensers. Hacksaw blades serve as cutting edges for aluminum foil and the like and make the dispensing of these materials a fast, one-hand operation. You can also see when you're getting low on wraps, as the rolls are not concealed in awkward boxes.

The unit shown is painted with PPG Industries' semigloss latex enamel: Bohemian Blue for the sides, Candle Glow on all inside surfaces and New Rust on the dowels.

Materials used

The unit is constructed of 1/2-in. MDO (medium density overlaid) plywood. Having a very smooth surface, this is more costly than ordinary fir plywood, but it is well worth the difference for several other advantages. It is made with good-quality

inner plies and thus there are no large voids or splintery areas. An MDO panel does not warp easily and doesn't splinter at the edge when sawed. Its smooth, flat surface is especially well suited for painting.

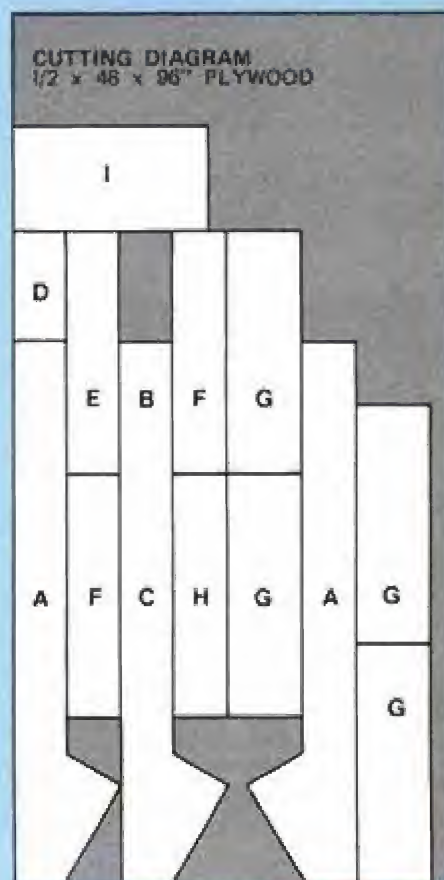
Cutting plan

All required pieces can be cut from one 4x8 panel if you follow the cutting plan shown. The initial cuts can be made with a sabre saw or circular saw. Whatever saw you use, be sure

MATERIALS LIST—KITCHEN ORGANIZER

Key	No.	Size and description (use)
A	2	1/2 x 10 3/8 x 60" plywood (side)
B	1	1/2 x 3 1/2 x 34 1/2" (approx.) plywood (divider)
C	1	1/2 x 10 3/8 x 22 5/8" (approx.) plywood (divider)
D	1	1/2 x 5 1/2 x 11 1/2" plywood (divider)
E	1	1/2 x 5 1/2 x 26 1/2" plywood (top)
F	2	1/2 x 5 1/2 x 26 1/2" plywood (shelf)
G	4	1/2 x 6 3/8 (approx.) x 26 1/2" plywood (shelf)
H	1	1/2 x 5 1/2 x 26 1/2" plywood (bottom)
I	1	1/2 x 11 x 27 1/2" plywood (front)
J	4	1"-dia. x 31" dowel
K	3	1/2"-dia. x 27" dowel
L	4	1 1/2" corner brace with eight 1/2" No. 6 th screws
M	6	12" hacksaw blade
N		1/2" No. 6 th screw (as reqd.)
O	1	1/4 x 8 x 12" hardboard or plywood (jig)

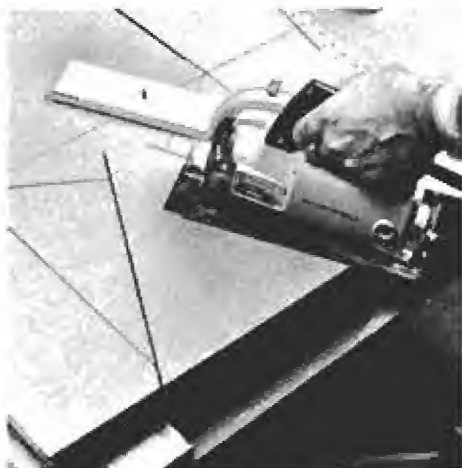
Misc.: Carpenter's glue, paint, sandpaper.



Design: Lester Walker AIA
PM color photos: Harry Hartman
Black-and-white photos, construction: Rosano Capotosto

to use a smooth-cutting plywood blade and set up your guides carefully so that you will have finished cuts in one step. Remember to allow for the saw kerf when you lay out the cutting pattern.

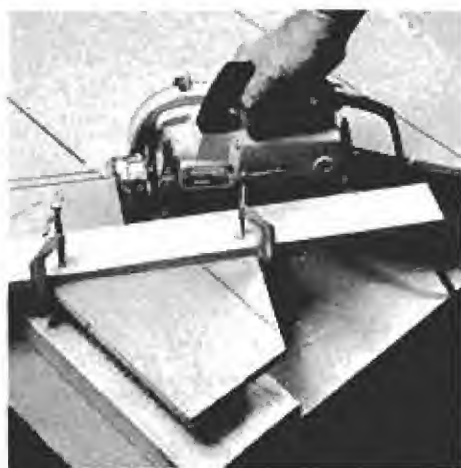
A 4×8 panel can be cumbersome to work with, so always have it properly supported for its entire length. Readjust your supports after each



Make the lower, angled cuts of the sidepieces with circular saw and guide strip.

cut and avoid a situation in which it will be awkward to make the full length of the cut in one run.

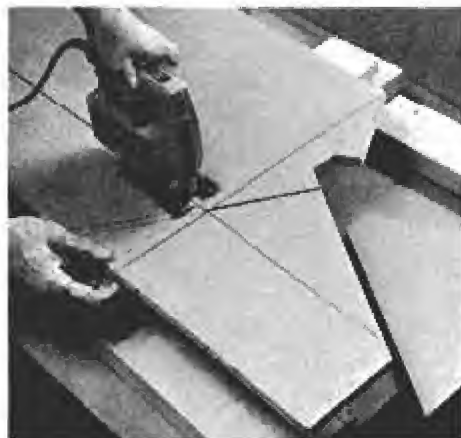
Make the first cut across the panel to yield the piece from which the front (I) is cut. This procedure will allow you to make several lengthwise cuts to get smaller sections that are easier to handle. Next, use clamps and a straight strip of wood



Reset the guide, even for short cuts, each time you make a cut with the circular saw.



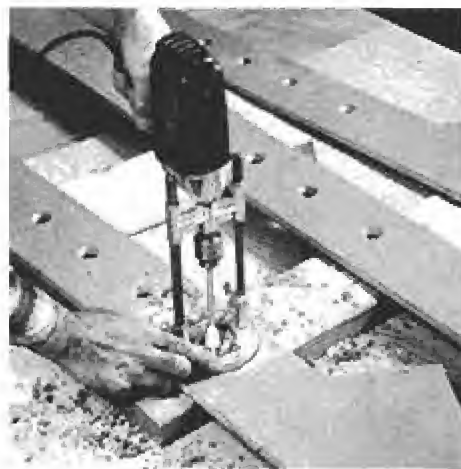
Always extend the guide strip beyond the edge of workpiece. Cutting diagram is designed to allow removal of waste piece.



Complete the circular saw cuts into the corners with a sabre saw. Cut slowly with steady hand or use a straightedge guide, carefully positioned to yield a clean line.



Sandwich-clamp three vertical members together (before centerpiece is cut into two dividers). Finish-sand exposed edges only. Use 120-grit, then 150-grit paper.



Use a drill press or portable drill guide to assure boring the holes straight. Place workpiece on scrap and bore through for a clean hole. Pilot holes make job easier.

as a guide to make the angled cuts for the sides. Cut to within 1 in. of the inside corners with the circular saw, then use the sabre saw to finish the corner cuts.

Although the center divider consists of two pieces (B and C) initially, cut it as a single unit exactly like the two sides. Then clamp all three together and finish-sand the edges that will be exposed.

Boring the dowel holes

Mark center points for the 1½-in.-diameter dowel holes on one side of the sandwiched pieces. Use a 1½-in. spade bit and be sure to back up the work with a wood block to prevent tearing as the bit breaks through. Since good alignment of the holes is important, use a guide with your portable drill or use a drill press.

Before separating the three pieces, mark off the measurements for the shelves on both sides. Join these respective marks across the edges, front and back, with a straight pencil line.

Now, separate the sides and centerpiece and mark the center points for the ½-in.-diameter dowel holes in the centerpiece. Note that the holes for the small dowels are bored through the centerpiece, but are bored only ¼ in. deep in the inside surface of each sidepiece. This requires the use of a twist drill with a bit stop.

After the holes have been bored in the centerpiece, connect the marks on the front and back edges to produce the 60° and 90° angle lines. Cut piece B-C into the two dividers, B and C.

The angled shelves are cut to size with a 30° bevel on the front and back edges. A table saw is ideal for these cuts, but they can be made as well with a guide and a portable circular saw.

A jig for edge-lap joints

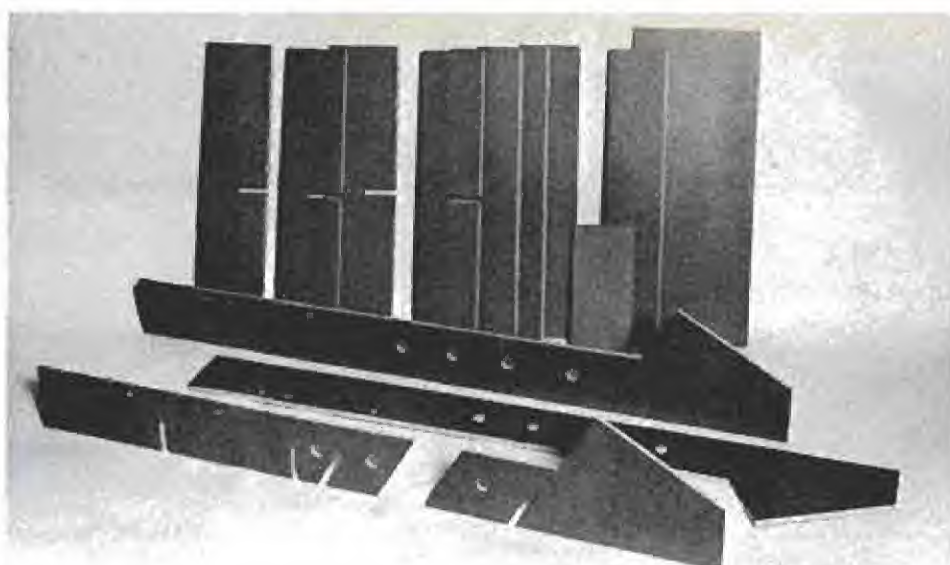
Edge-lap joints are used to attach the shelves to the center dividers. These are cut with a sabre saw and a simple jig.

To make the jig, cut a piece of ¼-in. plywood or hardboard to 8×12 in. To determine the width of the slot in the jig, measure the width of the saw base and add ½ in. (thickness of the stock). Then subtract the kerf (thickness of the saw blade).

The length of the slot should be more than 3½ in. (half of the angled shelf width before bevels), plus the distance from the front edge of the sabre-saw shoe. Cut the slots before you make the bevels. Note that the slots in shelves F should be exactly half the width of the shelf and the divider (B) or 2¼ in., as these joints



Secure the cutting jig to workpiece, using a hand-screw or C-clamp. Make opening in jig long enough to cut both 60° angle and 90° angle slots. Use the sabre saw only.



Shown here ready for assembly are parts of the kitchen organizer cut from one 4x8 plywood panel. Use MDO (medium density overlaid) plywood for best results.

are both positioned at right angles.

Before using the jig on a workpiece, make test cuts in scrap to check the fit of the joint produced. The parts should fit together easily without gaps.

Assembling the organizer

Attach the two upper shelves to the center divider and nail in the short vertical divider (D). Insert the ½-in. dowels.

The shelves will automatically be positioned on the center dividers, but you should use temporary cleats tacked to the sides in order to obtain an easy, accurate assembly of the sides to the shelves. Tack cleats to the sides with finishing nails. Leave the heads protruding so the cleats can be removed easily after assembly.

Use carpenter's glue and 1½-in. (4d) finishing nails on all butt joints. If you bore small pilot holes for the nails in the sides in advance, you'll have an easier time getting them in line and centered. Attach the front panel last.

Now, set all nailheads and cover them with a wood filler. Finish-sand with 120-grit paper and round over all edges slightly.

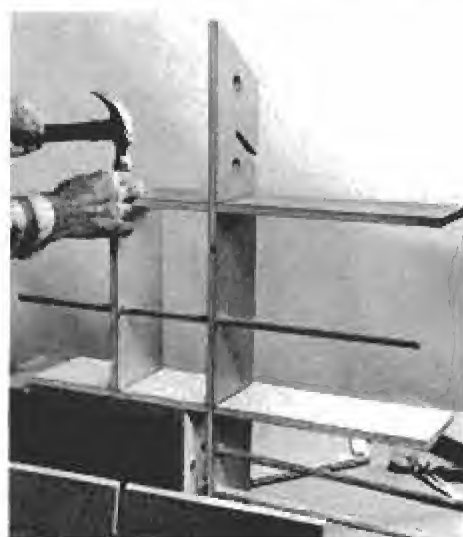
Positioning the blades

Buy inexpensive hacksaw blades or use old ones. Use ¼-in. No. 6 roundhead screws to attach them to the shelves. Position the blades so that the serrated edges overhang the shelf by about ¼ in. If you grind the rounded ends square, the cutting edges of abutting blades will be continuous for a nice finishing touch.

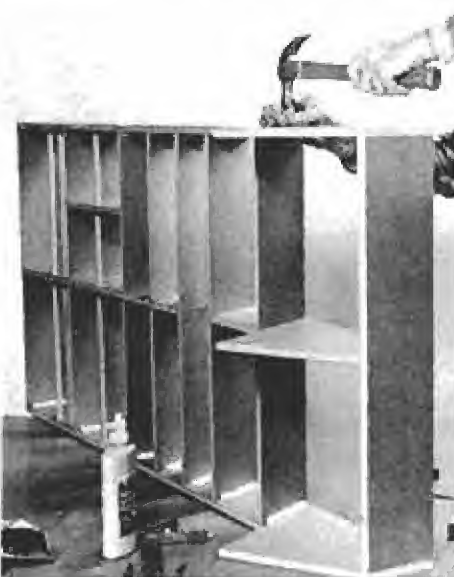
Attach four 1½-in. corner irons flush with the back to permit hanging.—*Rosario Capotosto*



Temporary cleats are tack-nailed below each shelf location to simplify assembly. This procedure improves accuracy.



Begin assembling shelves and dividers. The small divider must be placed in position with a dowel before end is attached.



After all parts are attached to center divider, including dowels, sides are easily added using nails and carpenter's glue, with cabinet turned on its side as shown.



Even dull hacksaw blades will work well as cutting edges for the various wrappings.

Build a headboard to match bedroom furniture



Sliding doors of headboard, unfinished here, close off the center area or ends.

A simple design and store-bought carvings make it blend with a bedroom set.

by C.E. Banister

This attractive bed headboard was designed to be slightly oversized for a single bed of standard 39-in. width. By extending the horizontal measurements, it can be built to match larger beds without altering either its appearance or function.

The headboard has two convenient shelves for books, knick-knacks, a radio or other items.

The choice of material is a matter of preference. I used lumber-core plywood except for the front panel, doors and back, which are of 1/4-in.

birch plywood. Edging tape was applied to the exposed edges of the shelf and top before painting.

Start by cutting the ends, partitions, shelves and top to the sizes specified. Use a grid as shown to transcribe the scroll patterns. A point on the grid and a point 19-1/2 in. from the bottom gives the 5° angle cut in the front edge of each end. After the scroll design is cut, break the edges of the scrolls, using a 3/8-in., rounding-over bit and router.

Note that each partition requires 7-3/4-in.- and 6-3/4-in.-long blind dados in the shelf and top, respectively. Measured from the back edge, this measurement includes the 1/4-in. rabbet in each piece to receive the plywood back. The front edges of the partition are rounded over with a 1/4-in. bit. If the dados are cut with a 3/4-in. router bit, the partition and edge will fit neatly in the dado.

Cut all remaining grooves and rabbets in these pieces. Be aware that the sliding doors require

grooves at a 5° angle in the top and shelf. The grooves should be 1/16 in. from the rounded end of the blind dados for the partitions.

Next, cut to size all rails, the back and front panels and glue blocks. Groove the two front rails to receive the front panel.

Cut the cleats and attach them to the rails with 1-1/2-in. No. 12 flathead wood screws and carpenter's glue. Then attach the upper rail to the shelf in the same way, but use 2-1/2-in. screws.

These parts of the headboard may now be assembled. The photograph on page 105 shows one assembly method, using pipe or bar clamps. The ends are attached with glue and 1-1/2-in. No. 12 flathead screws.

The sliding doors should be checked for proper fit before glue is used. You should be able to insert the top of each door in the top groove, then lower the door into the lower groove.

The next step is to insert the front

panel in the rail grooves and attach the lower rail and cleat to the ends.

All glue blocks may be glued in place with C-clamps and protective blocks or installed using screws. If screws are used to secure the caster blocks, be sure the screws won't interfere with caster installation.

Transfer the scroll pattern from the grid for the pediment and make the cut. Round over the edges with the same router bit used for the scrolls. Add the pediment to the case with screws and glue.

After applying glue, affix the wood carvings to the doors as shown.

Attach the half round moldings to the end panels with glue and 1-in. brads. At least two kerf cuts will be necessary in the half round at the 5° angle. After the glue dries, fill the kerf cuts with wood putty and sand smooth. Mark the position for the



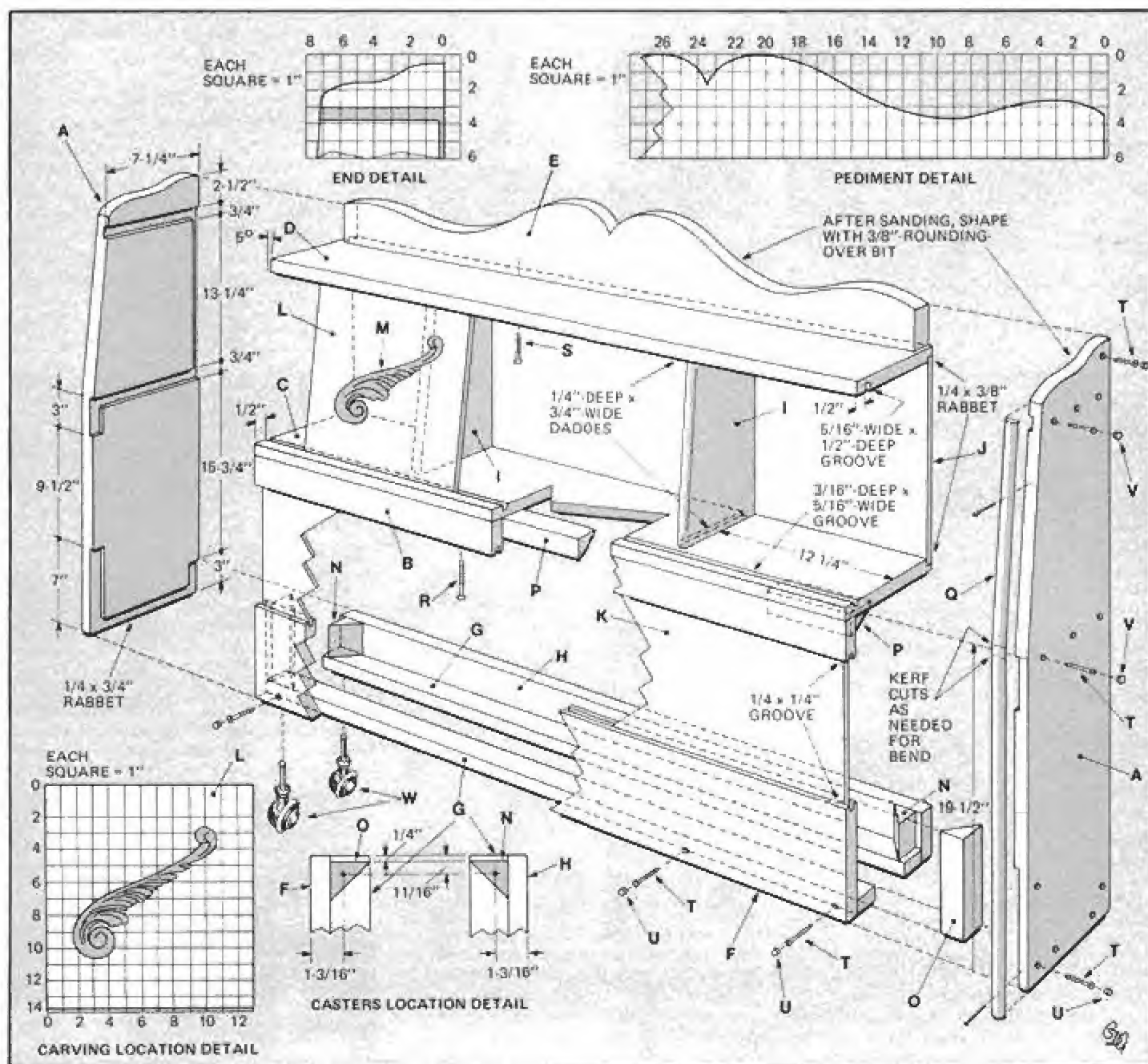
Assembly begins using glue, screws, bar clamps and C-clamps. C-clamps apply light pressure to blocking underneath shelf. Use blocks with clamps to protect rail edge.

caster stems carefully, bore the holes and tap casters into place. Finish the headboard with paint. You may want to apply an antique finish to the carvings.

MATERIALS LIST—HEADBOARD

Key	No.	Size and description (use)
A	2	¾ × 8½ × 36" lumber-core plywood (end)
B	1	¾ × 2¼ × 47" lumber-core plywood (rail)
C	1	¾ × 8½ × 47" lumber-core plywood (shelf)
D	1	¾ × 7¼ × 47" lumber-core plywood (top)
E	1	¾ × 6 × 46½" lumber-core plywood (pediment)
F	1	¾ × 7 × 47" pine (lower rail)
G	2	¾ × 1½ × 47" pine (cleat)
H	1	¾ × 3 × 47" pine (back rail)
I	2	¾ × 5¼ × 7¼ × 13¼" lumber-core plywood (partition)
J	1	½ × 14 × 47" plywood (back)
K	1	½ × 10 × 46½" plywood (front panel)
L	2	¼ × 13 × 13¼" lumber-core plywood (door)
M	2	wood carving, Craftsman Wood Service Catalog No. 45-1540-41
N	2	1½ × 1½ × 2¼" pine (blocking)
O	2	1½ × 1½ × 6¼" pine (blocking)
P	3	1½ × 1½ × 6" pine (blocking)
Q	1	¾ × 9" half-round molding to suit
R	4	2½" No. 12 th wood screws
S	5	1¼" No. 12 th wood screws
T	32	1½" No. 12 th wood screws
U	25	wood plugs
V	12	button plugs
W	4	casters, Shepherd Deluxe No. SSE 2001AC

Misc.: finishing nails, carpenter's glue and paint.



WORKSHOP MINICOURSE

MORE ABOUT FINISH CARPENTRY



Door casing (trim) should be set back a uniform distance from jamb edge; $\frac{1}{4}$ in. is the usual reveal. Mark the setback in several places on the side and header jambs.



Cut the miter at one end of the casing, then mark casing length from the inside corner. The length of the casing includes the $\frac{1}{4}$ -in. reveal, as shown in the top photo.



To guarantee that your miter joints will stay closed, install them as follows. Cut the header casing to suit the span between the vertical casings. Then apply white glue sparingly to the mating surfaces.



Correct door-trim detail at the floor. The door casing extends to floor and the baseboard trim abuts the casing, as pictured.

The finish carpentry that you are most likely to encounter as a homeowner will involve "trimming out" a room. This includes the installation of those moldings and trim that are intended to conceal joints and framing details, and give the room a finished appearance.

Such work also includes the application of baseboards, door and window casings, outside corner guards, ceiling moldings, chair rails and the like. An important thing to keep in mind about finish carpentry is that sloppy work is a sure sign of a careless carpenter. For example, there is no excuse for an opened miter joint



To install door (and window) casing, use 4d finishing nails through thin edge into jamb, and 6d nails through the thick edge into the stud behind. The nails in casing should be spaced about 10 to 12 in. apart.



Next, bore slightly undersize lead holes through the joint, as shown above. The bit that you select should provide a tight fit for the finishing nail that follows.



To keep an outside corner miter closed, as in a baseboard installation, first apply glue to the miter. Then secure it with 4d finishing nails, as shown here. If you plan to stain and varnish the trim, be sure to remove all traces of glue from the surface.

in the casings around windows and doors. If you practice the method shown in the photos, your miter joints will stay closed for good—as they should.

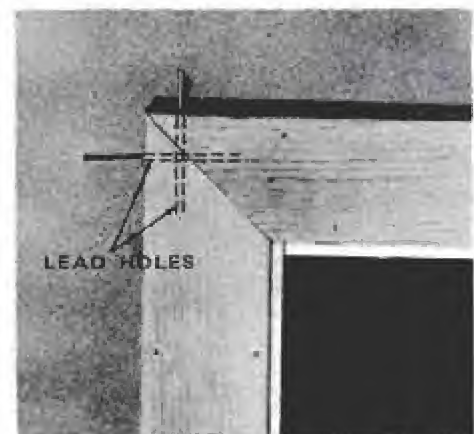
Last month we covered some finish carpentry basics, but here is some additional information you should know to add to your bag of tricks.

Use the right tools

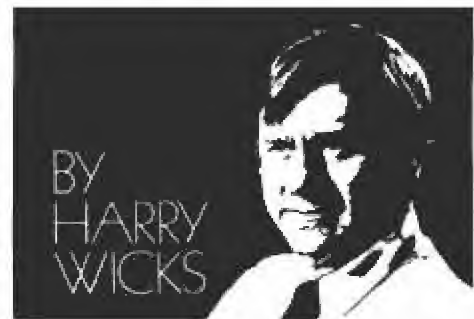
■ **Hammer**—For finish work, many professional carpenters prefer to use the lighter 13-oz. hammer; I do, myself. But if you are doing trim work that requires hefty finish nails (10d or heavier), you should switch back to your 16-ouncer, especially when you're using the nailset.

■ **Saw**—Buy a top-quality crosscut saw and keep it razor sharp. When cutting trim, for instance, the saw should have little, or no, set. My favorite saw for trimming is a 10-pointer that's 24 in. long, and has no set.

■ **Square**—Purchase a first-rate combination square and give it the treatment that accurate measuring tools deserve. Don't toss it carelessly into your toolbox, where it can be banged out of square. **PM**



Secure joint with two 6d finishing nails, as shown. Set the nails with your nailset.



BY
HARRY
WICKS

PM'S HOME ENERGY GUIDE



**HERE ARE DOZENS
OF IDEAS FOR CUTTING
THE COST OF ENERGY
IN YOUR HOME:**

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- ☐ More for less—how to get more light while lowering your monthly electric bill.
- ☐ Plus more, lots more.



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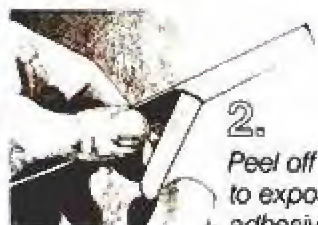
It seems incredible, but without 3M V-Seal™ Weather Strip, you may be doing just that. In an average home*, in just one day, 3M V-Seal could stop more than enough air to fill these three balloons. Enough to cut the heating bill more than 20%!

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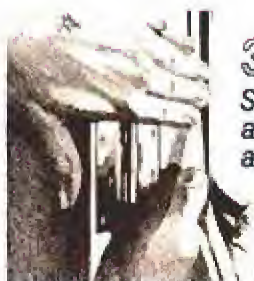
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3.
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*Average home: 1600 to 2000 sq ft, with 275 ft. of window crack and 57 ft. of door crack. Infiltration measured by American Society of Heating and Refrigeration Engineers standard "crack" method.

3M Hears You...

3M

8 solar add-ons that will help heat your home

Passive solar collection is a sure way to keep down heating costs.



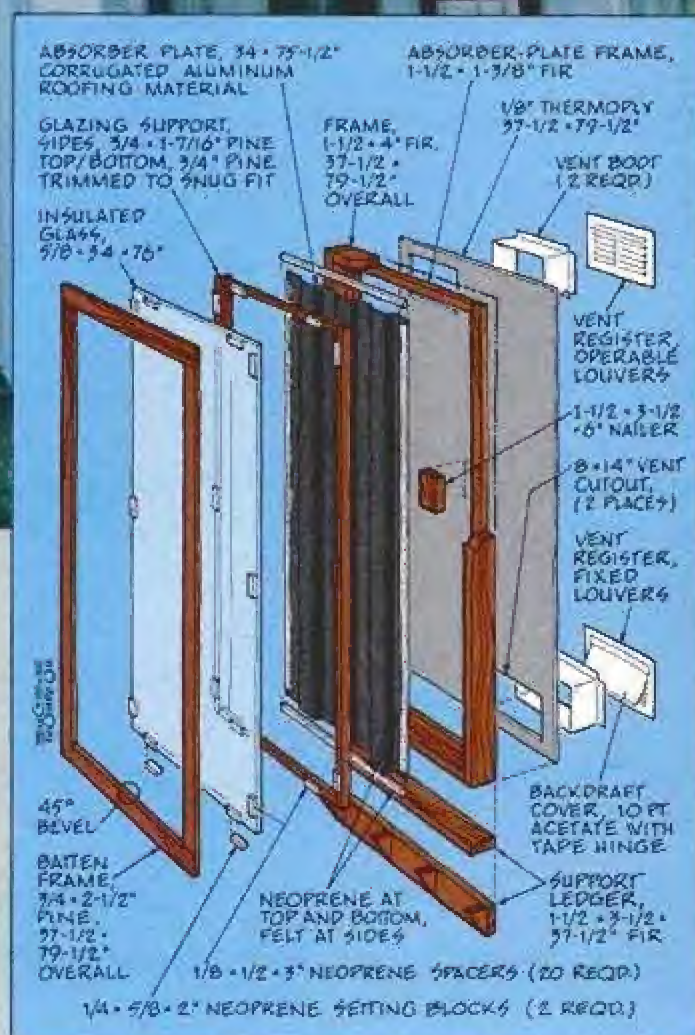
This homeowner has added four TAP solar wall collectors. Each one could save up to 25 gallons of heating fuel per season.

by Richard L. Dempewolf

Are there any *really* effective solar systems that are simple, easy to build and inexpensive enough to justify the time and trouble to install them? An emphatic "yes" is the answer given by experts at a recent National Passive Solar Conference at the University of Massachusetts. From the passive (non-powered) systems presented at the conference, PM has chosen eight that it considers the most practical, effective, easy-to-build and inexpensive to install in an existing home.

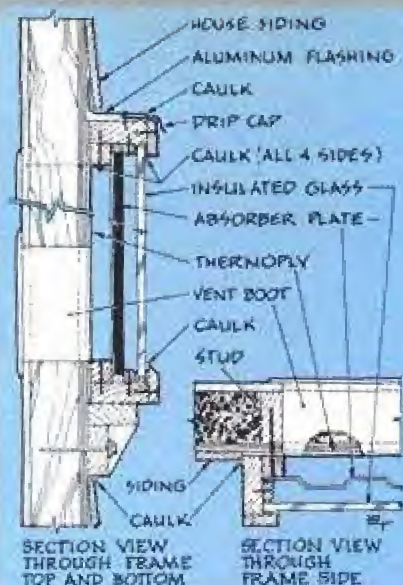
1 TAP collector

One of the simplest, most effective solar collector panels devised, the TAP (thermosiphon air panel) is nothing more than





BEFORE: This house had a south-facing side wall with enough space between windows to add several TAP wall collectors. The finished job (see preceding page) supports the statement that collectors need not detract from the overall appearance of a house. Instead, they give this one an "open," expansive look. Details for attaching the collector frame to the house wall are shown at right.



a glass-covered box with a heat-absorber plate of corrugated aluminum, painted black, running up its center. (See drawing on the preceding page.) TAP's name comes from the fact that the rising warm air in the space behind the aluminum plate creates a siphoning effect that pulls cool room air—near the floor—into the unit through a vent, draws it up through the warming channel and out through a top vent into the room again.

The TAP wall collector has endless advantages. About \$225 will buy readily

available materials for a 3-ft. x 6-ft., 6-in. panel which will accommodate a standard double-glass replacement panel for a sliding patio door (Note: If you're stumped on getting any solar materials, see the source list at the end of the story.) The TAP collector has little effect on the eye appeal of a house. It is simple enough for anyone with some assistance to build and install in a day. Numerous units have been installed by members of SUEDE (Solar Utilization Economic Development and Employment), using designs by Total Environ-

Collectors simulate the look of floor-to-ceiling windows



AFTER: Four collectors equally spaced between and flanking windows of this home (above) keep its design balance, and give it open and airy look.

BEFORE: First floor south wall of house (left) had room for four wall collectors without changing window placement.



PM photos: Center for Ecological Technology, 74 North St., Pittsfield, Mass. 01201
Technical art: Eugene Thompson

Installing a TAP



1 A wall facing south with limited windows is an ideal site for a collector installation.



5 Assemble a 1 1/2 x 4-in. frame to a size based on the glass dimensions. Here, an insulated sliding glass replacement panel is used. Glue and nail Thermoply to the frame; install support, frame on house.



9 Cut the metal absorber plate. Clean with cleanser, then a vinegar solution. Apply high-temperature flat black paint.



13 Cut glazing support members and seal with water white shellac. Measure the thickness of the glazing from the outer edge of the TAP frame. Nail the support to frame.

solar wall collector



2 Remove siding (centered over a stud) to accommodate TAP frame and support.



3 Cut upper and lower vent openings in adjacent stud cavities at the extremes inside the TAP frame; finish cuts indoors.



4 Nail aluminum vent boots in the upper and lower vent chambers, after cutting off excess that extends beyond the inside wall. Secure one boot side to the stud.



6 To ensure that the frame is airtight, seal up all the joints with silicone caulk.



7 Construct the absorber plate frame and install it inside the first frame.



8 The acetate flap duct taped to the bottom vent stops reverse airflow at night.



10 When splicing sections together, seal the seam with silicone caulk; then secure with Pop rivets. Before installation, seal top and bottom edges with adhesive foam.



11 Glue and nail a nailer centered on the Thermoply; weatherstrip the absorber plate sides; attach it to the nailer and frame.



12 Secure the flashing and drip edge.



14 Attach the neoprene setting blocks and spacers, position glass and caulk.



15 Add the batten frame to finish the job.

mental Action Inc. of Harrisville, N.H.

TAP wall collectors can be used effectively on any wall that faces southeast to southwest. Check locations carefully to avoid obstructions such as ductwork, chimneys and plumbing waste lines. Vents at top and bottom call for a clear shot through the exterior wall. Designers also warn that the bottom vent should not be near a floor register or radiator.

How much heat will a TAP produce? Installations in southern New England saved an average of 25 gallons of fuel oil per panel during a typical recent winter. At today's prices, four panels would shave about \$125 from an oil heating bill, paying for themselves in five years or less. According to the experts, installing a low-

powered fan in the top vent to pull air through the panel will increase its efficiency an estimated 20 percent.

2 Window collector

For a house with double-hung windows on the south wall, these small, box-like collectors are ideal for retrofit. No wall penetrations are required. No changes, structural or otherwise, need be made in the house. The units are small and light enough to handle with relative ease. They can be removed in summer.

Since these collectors are smaller than TAPs, they won't be quite as effective. But two of them will produce enough warmth on a sunny winter day for a room about 14 x 20 ft. without auxiliary heat.

Like the TAP, window collectors work purely by convection. Sun shining through the double-glass surface warms the black-painted, corrugated aluminum absorber plate. Cool room air drops through the bottom insulated channel and is siphoned upward through the top channel, acquiring heat from the absorber plate as well as from the glass as it rises and pours into the house.

Since most first-floor windows are close to the ground, these collectors usually are sloped to provide as much length (5 to 8 ft. for maximum surface) as possible. To function properly, the angle of slope should not be less than 30° from the ground. Most efficient airflow is achieved at angles of 45° to 60°. The bottom corner of the collector should rest on blocks to keep it off wet ground.

As with most passive collectors, the window unit's end vents, which pass through the window opening, are most efficient if they're the same size as the collector's air channels. This, of course, limits the width of the collector to the win-

dow width. While wider air channels can be slanted in from each side to accommodate a narrow window—such units will not be as efficient.

Both cool- and warm-air channels should be 4 in. deep for a 6- to 8-ft.-long collector; 3 in. for one only 4 or 5 ft. Whichever design is followed, allow for weath-erstripping around the box.

Window collectors can be installed vertically flat against the exterior wall, provided that the distance from window to ground is 4 ft. or more. Efficiency of vertical and angled units can be enhanced by rounding the channel corners with sheet aluminum baffles, as shown below. Pop rivet the inner baffle to the absorber plate. Embed the outer baffle into the insulation. This way, incoming air will flow up both sides of the absorber plate, picking up heat from both sides of the metal and from the glass surface, as well. Don't use polystyrene insulations that may expand and melt at higher temperatures.

3 Tromb  wall

For a solar retrofit system to produce heat at night—unlike the retrofits previously mentioned—a method must be devised to store some of the heat collected during the day. Heat can be stored in rocks, water, masonry, concrete or other thermal-mass materials. This heat is released into living spaces when their temperature drops.

The Trombe wall (named after French architect and inventor Dr. Felix Tromb ) is one of the simplest and most effective means of providing such heat passively. It is a single-channel collector in which a section of the house wall (usually a space between south-wall windows) becomes heat absorber and thermal mass. To do this, it must be of concrete, masonry or

other thermal-mass material with vents top and bottom, as shown below.

To adapt the system to a frame house, the existing wall can be replaced with solid or filled concrete block.

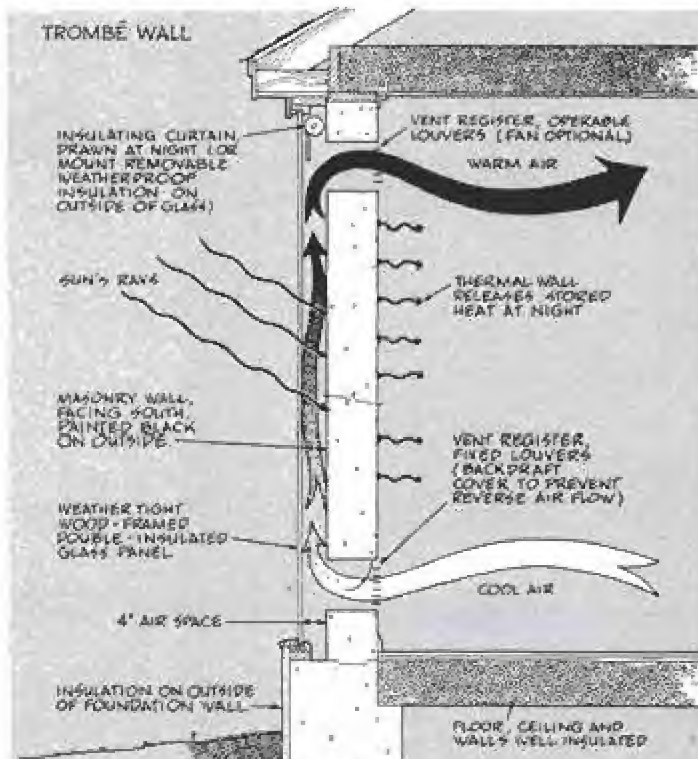
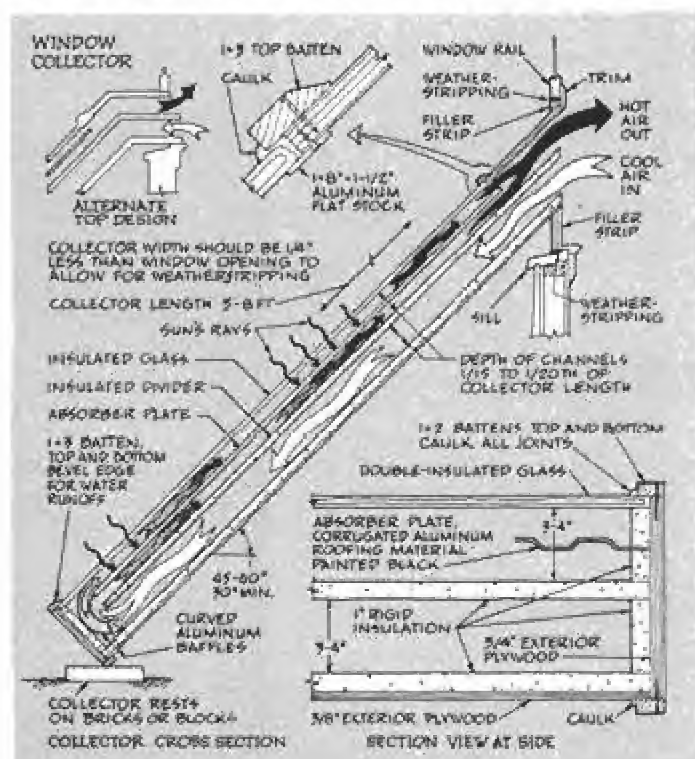
To do a top job, any thermal wall should be at least a foot thick, though 6 to 8 in. will store a reasonable amount of heat. (Anything over 18 in. is wasted material.) It is important to dig out and insulate (outside) the foundation wall on which the thermal wall sits, or considerable stored heat may be lost from it in cold weather. The rule of thumb for vents is about 12 sq. in. of vent for each foot of solar-wall width.

Double glazing is mounted in a weath-ertight, airtight wood frame, about 4 in. from the wall, to ensure flow of cool air into the floor-level vents, up the face of the warm Tromb  wall and back into the living space via the top vents. To prevent reverse flow at night, flap dampers are installed. Additional insurance against heat loss is a hand-cranked or motor-driven insulating window curtain installed across the top of the air channel. Alternatively, weatherproof insulation is successful on outside windows of these walls.

It's important not to surface the inside wall with any material that will block heat radiation—particularly wood paneling. Even gypsum panels are not recommended. A thin coat of finish plaster and paint are okay, but the natural masonry, or merely a layer of cement paint will inhibit the least amount of heat.

4 Shim wall

What if you have a frame house with a large expanse of south wall, but you don't want the trouble and expense of replacing it with masonry—and you need more than the daytime heat provided by TAP wall collectors or window-box collectors? A



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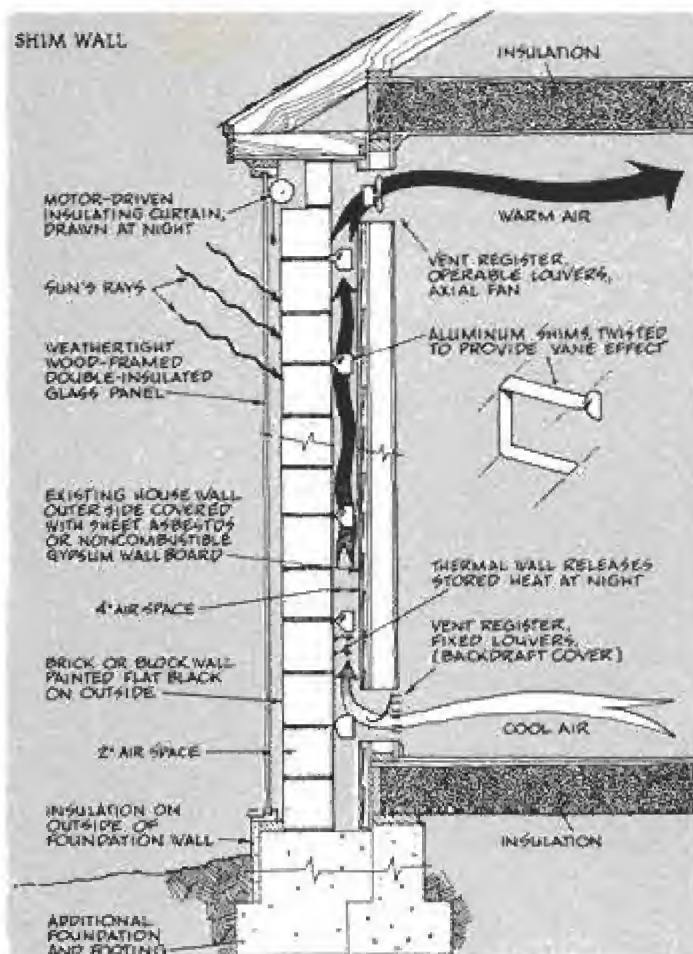
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shim wall (above) may be the answer.

This is a brick or solid concrete-block wall constructed on its own insulated foundation, about 4 in. out from the existing south wall of the house. It has a double-glazed frame similar to the Tromb  wall, except that the glass is only about 2 in. from the wall, painted flat black.

This solar wall is particularly well adapted to buildings with 2 ft. or more of overhang. On other dwellings, extend the roof to cover wall and glazing.

The secret of this type of solar wall involves the shims—strips of sheet aluminum about 3 in. wide that are wrapped around each block (or every fourth brick vertically and every second one horizontally) as the wall is laid up—in such a way that about 3 in. of one end of the metal sticks out into the space between masonry wall and house wall. These ends are twisted slightly to give them a vane-like configuration. The shims conduct warmed air up the channel, out the top vent and into the room.

Before erecting the solar wall, the house wall behind it should be covered with a noncombustible material such as sheet asbestos or gypsum wallboard. There are two reasons: In case of overheating, the siding paint will not blister (it won't get hot enough to scorch or burn) and just as important, the air will have a smooth surface to move past, rather than shingles or clapboard.

Vents are cut through the frame wall at floor and ceiling levels to accommodate

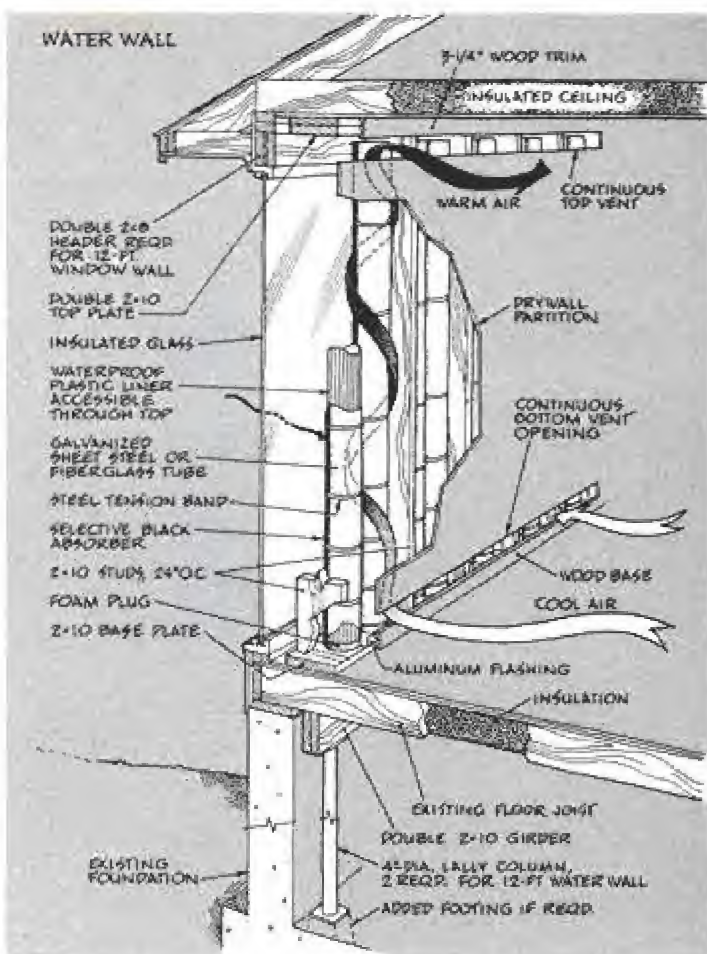
sleeves of standard metal ducting. Vent registers with backdraft covers are installed. A low-powered fan to enhance the flow of warmed air through the top vents moves air and avoids overheating.

Since the block or brick wall is an excellent thermal mass, warm air moves by convection into the living space at night and on dark, cold days. Insulation can be added to improve efficiency by preventing heat loss through the glass.

5 Water wall

If the major structural changes involved in concrete and masonry walls are more work than you're willing to undertake, a thermal water wall can be a good alternative. Actually, water is a better thermal material than the solids. Among its advantages are: 1, it stores about two-thirds more heat per cu. ft. than the next best material (dense rock); 2, The cylindrical or boxtype containers available for it can be mounted inside the building, behind a solar window in the existing south wall of the house (see "Direct-gain window" for description of solar windows.); 3, Because water itself is convective, it absorbs heat faster and transmits it to living spaces faster than the solids.

The amount of water required for a water wall can be calculated roughly at 1/2 cu. ft. (four gallons) for each sq. ft. of wall area. If your south wall has room for two 6x8-ft. solar windows backed up by a 12-ft. water wall, it would require 48 cu. ft. (384 gallons) of water.



Water weighs 62.5 pounds per cu. ft. To support that weight, a girder of two spliced 2x10s, supported by a pair of steel lally columns across the floor joints under the wall (above) is needed.

The solar windows are cut into the wall. A false wall with vents top and bottom becomes the new interior frame wall of the space to be heated. A water wall system can supply considerably more than 25 percent of your heat.

6 Direct-gain window

If you can't do anything else to give an existing house a solar assist, it should be possible to build a section of glass in the south wall, somewhere. By themselves, good solar windows with double or triple glazing can produce a net of up to 70,000 B.T.U.s per sq. ft. in a northeastern U.S. climate—nearly as much as solar collectors. Movable-panel or window-shade insulation drawn over solar windows at night can increase that net.

Standard-size, insulated glass replacement panels for casement or patio windows to use as solar windows are readily available at most building-material suppliers. Remove a section of wall large enough to be replaced by a frame for the fixed solar windows. It is important to install a doubled-up 2x6 (or 2x8) header (depending on the width of the opening) across the top of the opening to support severed studs as soon as possible. (See the drawing on page 115.)

While there is no further heat output

from solar windows after sunset, everything in the house on which the sun shines during the day (plus items out of the glare, warmed by the heat it produces in the room), acts as thermal mass after dark—furniture, floors, carpets, walls.

Direct gain from 300 sq. ft. of solar windows in a cold climate can provide 50 percent of the heat for a 1500-sq.-ft. house.

7 Sun space

Sun porches and greenhouses fall into the category of sun spaces. Today, the one most often built in residential context is the solar greenhouse.

A solar greenhouse features double glass to prevent excessive loss of heat through it at night. It may also incorporate sliding or pull-down insulation to cover glass areas after sunset. In addition, it has thermal mass in plastic water containers (3 to 4 gal. per sq. ft. of glass) or in a brick, stone or concrete floor laid on a bed of gravel or sand about a foot deep. This is enclosed by an insulated foundation wall similar to the drawing below. A plain thermal wall of block or brick, or a thermal wall with metal shims heats a thermal space that vents into a room.

Usually only the south-facing roof and sloping front of the solar greenhouse are glazed. Side walls are solid and fully insulated, except for an insulated access door and operable louvered air vents for summer. Most practical glazing units for solar rooms are standard, mass-produced, insulated-glass patio doors, which can be mounted on rabbeted frames.

Making a greenhouse leakproof can be tough. If you use a silicone caulk, check to

make sure it is one that will stick to a painted wood surface, and won't mildew in a damp environment. All framing members for the glazing units should be painted before assembly. Malcolm Wells, a solar architect with considerable experience in solar-roof skylighting, recommends a pitch of no less than 60° from the horizontal for greenhouse glazing, to ensure quick runoff.

While a solar greenhouse of moderate size (up to 10×20 ft.), on an average, well-insulated three-bedroom home won't provide more than 25 percent (somewhat more with a thermal space in back) of the dwelling's normal heating load, it also serves as dead-air buffer space.

How much does a solar greenhouse cost? In Massachusetts, over 100 have been built in the past five years, at costs from \$7.50 to \$35 per sq. ft. Much depends on whether you do the work or contract it.

8 Thermosiphon heat bank

For existing homes that happen to be built on a steeply south-sloping site, there is a completely passive thermosiphon-convection system that can produce up to 75 percent of a home's heating needs.

A concrete block bin, buried in the south embankment, is insulated on top and around the perimeter with 2 to 4 in. of rigid insulation, as shown below. Rocks housed in the bin provide thermal mass.

Collector panels of double or triple glass (similar to the TAP collectors), angled to the sun at about 45°, are

arranged along the south wall of the bin. Cool air is ducted from the floor of the living space to the lower rear section of the bin. From there, it moves upward through the collector, warming the top rocks. Then it passes through the upper ducts back into living spaces.

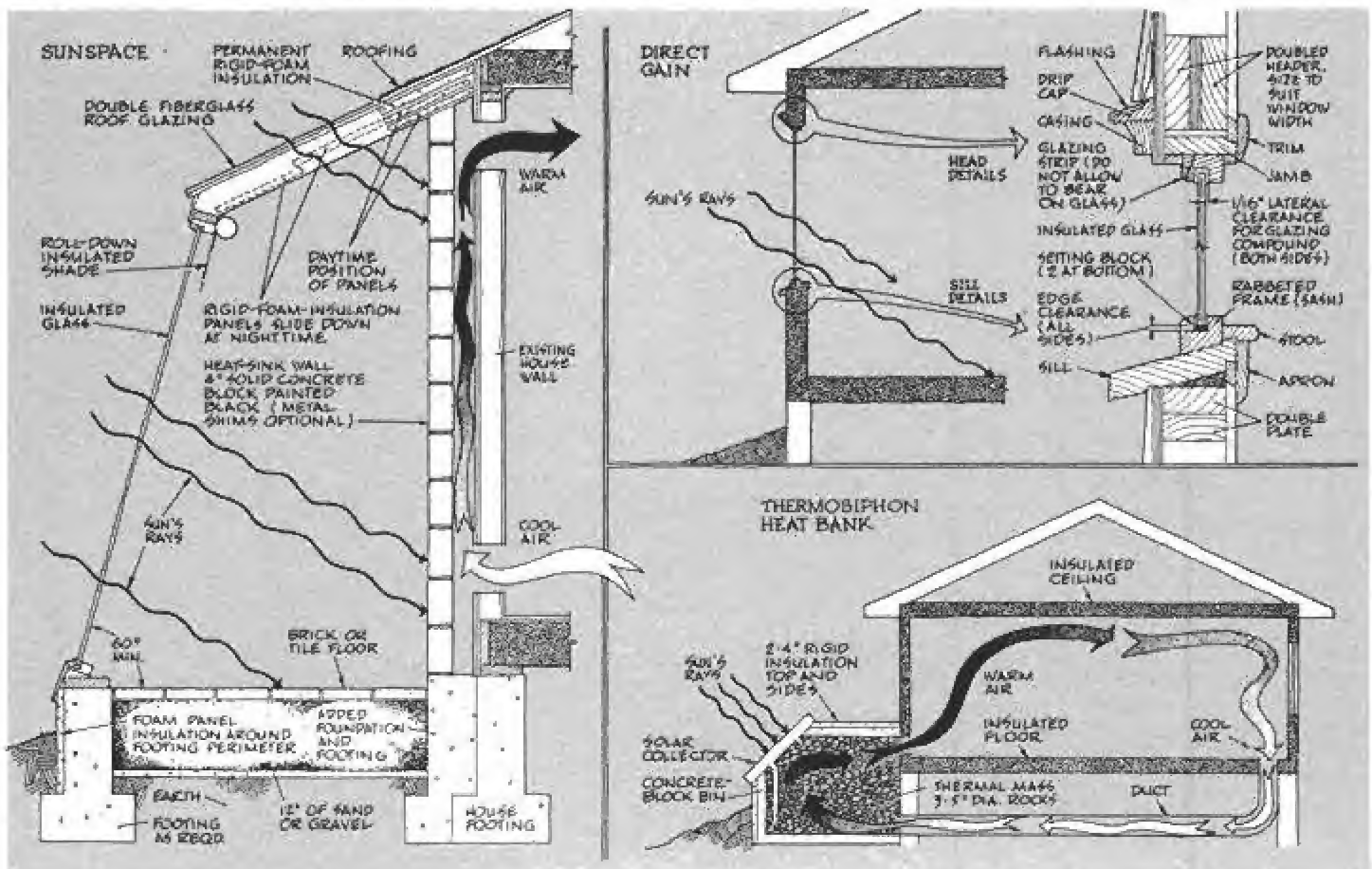
At night, reverse-flow dampers block loss of warm air down through the collector; cool house air is thermosiphoned through the bin, where rocks warm it en route, returning it to living spaces heated. To operate efficiently, the thermal mass is entirely below the building's floor level.

The passive systems described here can be adapted to given situations, provided you understand the concepts. Don't squeeze specified flow areas, or skimp on specified materials. In the end, you'll find that collectors can heat your home more comfortably with narrower temperature swings than fossil fuel systems. **FM**

SOURCES—MATERIALS

Most materials required in passive solar structures are readily available. However, following are sources of some materials you may have trouble finding:

- **Thermoply** (fiberboard with reflective foil on both sides): Simplex Industries, 3000 West Beecher Rd., Adrian, Mich. 48221.
- **Vent registers, fans and thermostats**: Consult a heating-cooling materials supplier or contractor; write to Kalwall Corp. at the address below for its catalog; or write to W.W. Grainger Inc., 5959 Howard St., Chicago, Ill. 60648 for a distributor.
- **Window curtains for night**: Homeworth Corp., 18 Main St., Yarmouth, Me. 04098; Shelter Institute, Bath, Me. 04530.
- **Water wall equipment and hardware**: Waterwall Engineering, Route 1, Box 6, New Paris, Ohio 45347; Kalwall Corp., address below.
- **Solar Components Div. Catalog**: Kalwall Corp., Box 237, Manchester, N.H. 03103. The company claims to have the largest solar mail-order house in the United States; 68-page catalog is \$3.
- **Center for Ecological Technology**: 74 North St., Pittsfield, Mass. 01201; (413) 445-4556. The staff answers energy-related questions from people across the country.



New wood-stove tests yield surprising facts about creosote

Don't worry when choosing firewood: Tests show soft, wet woods pose no greater danger of creosote buildup.

by John E. Gaynor

For years, conscientious homeowners have fretted about firewoods. Because they believed hard, dry woods would reduce the creosote hazard in the flue, wood-stove and fireplace users avoided the less expensive, more plentiful, soft and green woods. But recent tests conducted by Auburn University's mechanical engineering department, with aid from the Department of Energy, have produced some surprising discoveries.

Under certain conditions, hardwood can produce more creosote than softwood. Other tests indicate that seasoned wood may produce more creosote than green or wet wood. Although these tests were conducted on "airtight," free-standing stoves with metal flues, the results apply to any duct in which wood smoke is conducted away from a fire.

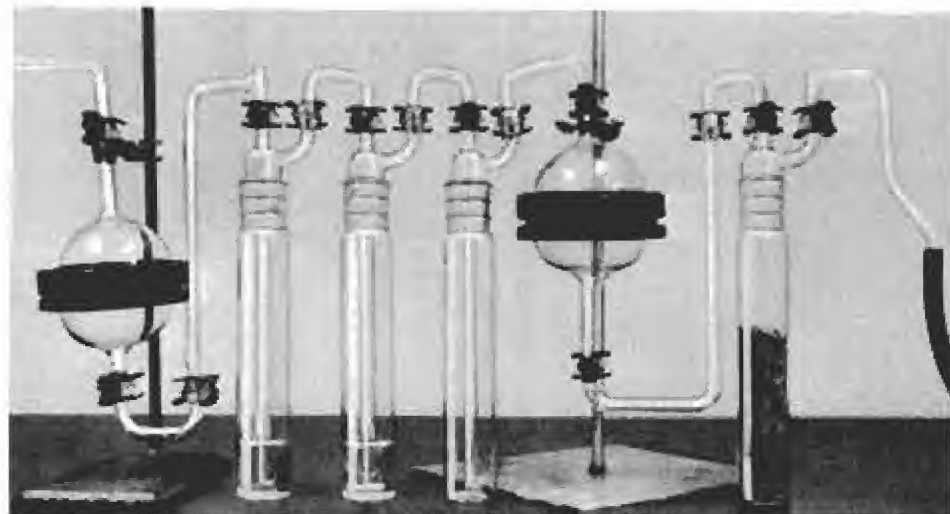
Creosote is a substance created by incomplete combustion. Some unburned matter (tars, or hydrocarbons as the scientists call them) always escape the fire. These hydrocarbons are absorbed by water vapor that is also given off by the fire, and the mixture goes up the chimney as smoke.

How creosote forms is shown in the drawing at right. In the cool, upper surfaces of the flue or chimney, the vapor mixture condenses. This condensed water vapor, mixed with hydrocarbons, is the highly flammable, black, sticky stuff called creosote.

As it builds up, creosote runs down the flue or chimney and collects on ledges, elbows and junctions. If not cleaned out regularly, it can eventually ignite, causing a serious and inaccessible fire.

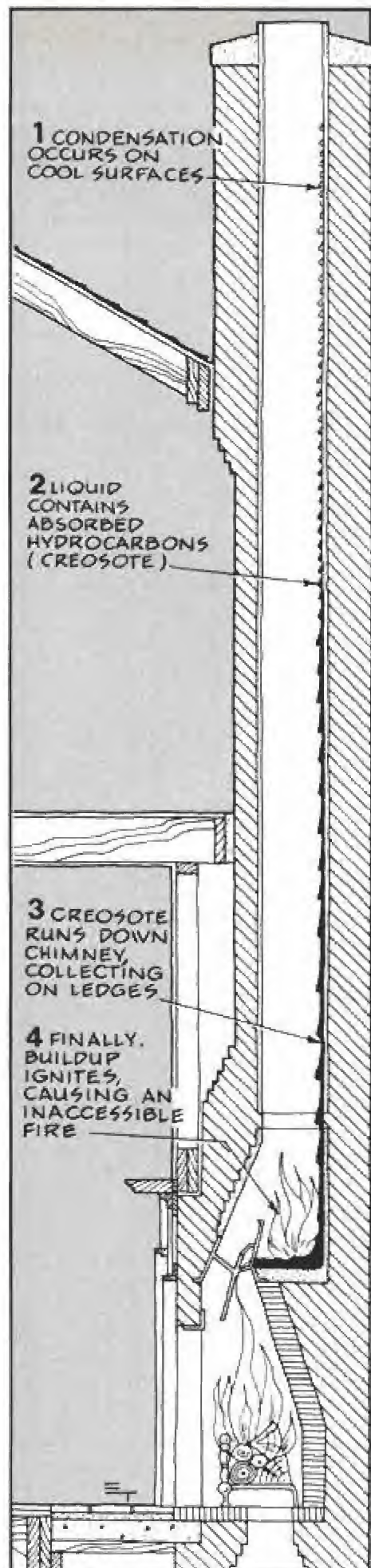
Until recently, hardwood was thought to produce less creosote than soft (resinous), wet woods. But the tests show otherwise.

The scientists at Auburn collected smoke from a probe stuck into a flue. They kept the smoke hot and filtered it to remove the particles with no function in forming creosote. Then they bubbled the smoke through cold water. This caused the creosote hydrocarbons to be absorbed and remain in the water. The scientists measured the quantity of hydrocarbons produced by identical amounts of hardwood and softwood in the same length of time. The tests showed clearly



Setup represents one of the tests conducted on wood smoke. Particles are filtered out in container at left from hot smoke

from flue. Creosote condenses in cold water in three middle bottles. Residual matter collects in containers at right.



Creosote collects in flue or chimney conducting smoke away from a solid-fuel fire. Check for creosote buildup regularly.

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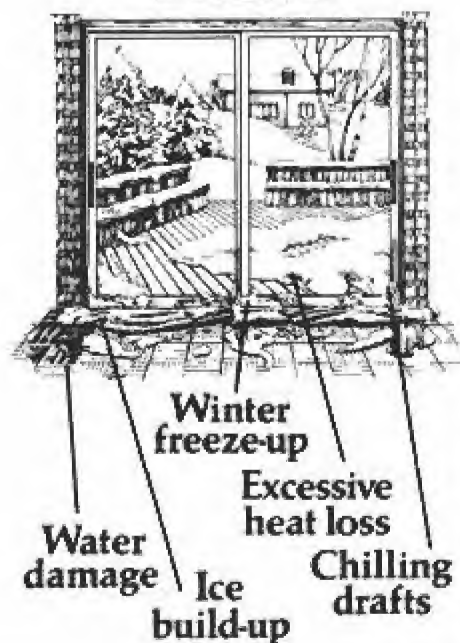
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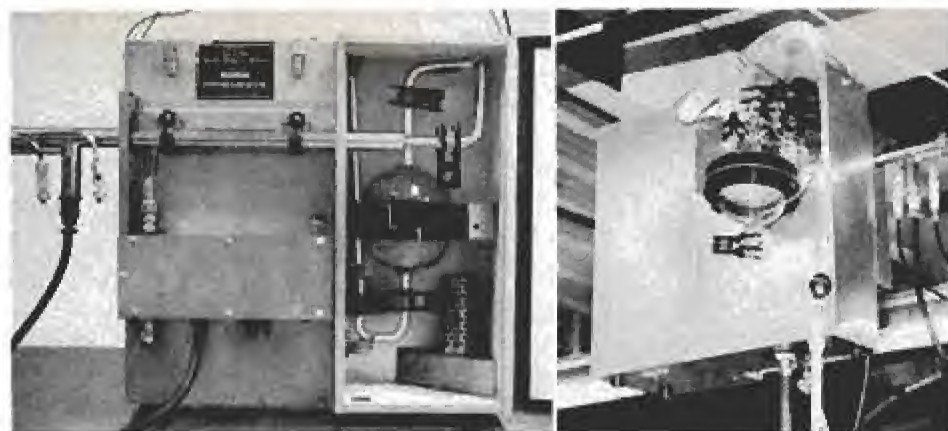
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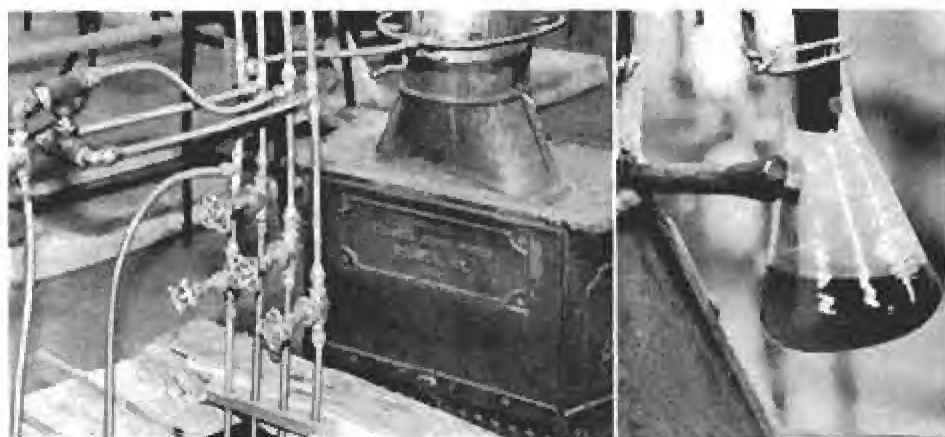


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Actual laboratory equipment looks like this. Particle-filter beaker is shown in its heated chamber (left). Smoke tube passes to other

side, where creosote is collected in bottles (not visible). Scientists call this equipment a Methods 5 Emissions Train.



Auburn University may have the only wood stove known with hot and cold running water. Cold water circulates through a dou-

ble-walled flue, causing creosote to condense and collect in beakers (right). Hot water and steam circulate to clean flue.

that hardwood produces more creosote.

Scientists theorize that the quicker burn rate of hardwoods causes more unburned hydrocarbons to escape up the flue. This, in turn, produces more creosote.

In other tests, scientists collected creosote as it condensed and ran down the inner wall of a double-walled flue in which cold water was circulating. This setup approximated the cooler conditions of a chimney or flue where it's near the exterior of the house. In the laboratory, the creosote collected in beakers. Scientists then measured the liquid collected under controlled circumstances.

The researchers used a special device to pass light through the creosote solutions and measure the creosote concentration. Again, there was less creosote in solutions produced from wet wood than from dry wood.

Scientists think a secondary combustion process occurs in softwoods, which they attribute to the "water-gas" reaction. As wood burns, water vapor, hydrocarbons and gases are forced from the core, through the charring surface areas of the wood. Here, additional gases are produced which help burn the heavier constituents of creosote in the fire.

The other explanation is called the "water-dilution effect." Wet wood sends more water vapor up the flue, which low-

ers the vapor dew point and causes more condensation to occur. But more vapor also goes out of the chimney and into the air, carrying hydrocarbons with it. Although you may get more condensation, your chimney will collect less creosote.

The question remains: What does one do about creosote? The only answer is to check your flue or chimney regularly. Check horizontal parts and couplings. Remove creosote by scraping it off.

To reduce creosote buildup in airtight stoves, allow a small, but fairly hot fire, to burn freely for 15 to 20 minutes. The hot, fast-moving exhaust tends to have a cleansing effect as some condensed creosote is revaporized and blown out the flue. This practice also works well in brick fireplaces, but only after flues and fireplaces have been cleaned thoroughly.

But remember, regular mechanical cleaning is the solution. As more people require this service, we should witness the return of the chimney sweep. If you don't want to handle this job yourself, check the classified directory under "Chimney cleaning."

For more information on wood heating, the researchers at Auburn have written a book entitled *Wood Burning Safety and Efficiency*. It's \$10, postpaid, from Wood Burning Innovations, 2507 Waterford Rd., Auburn, Ala. 36830.

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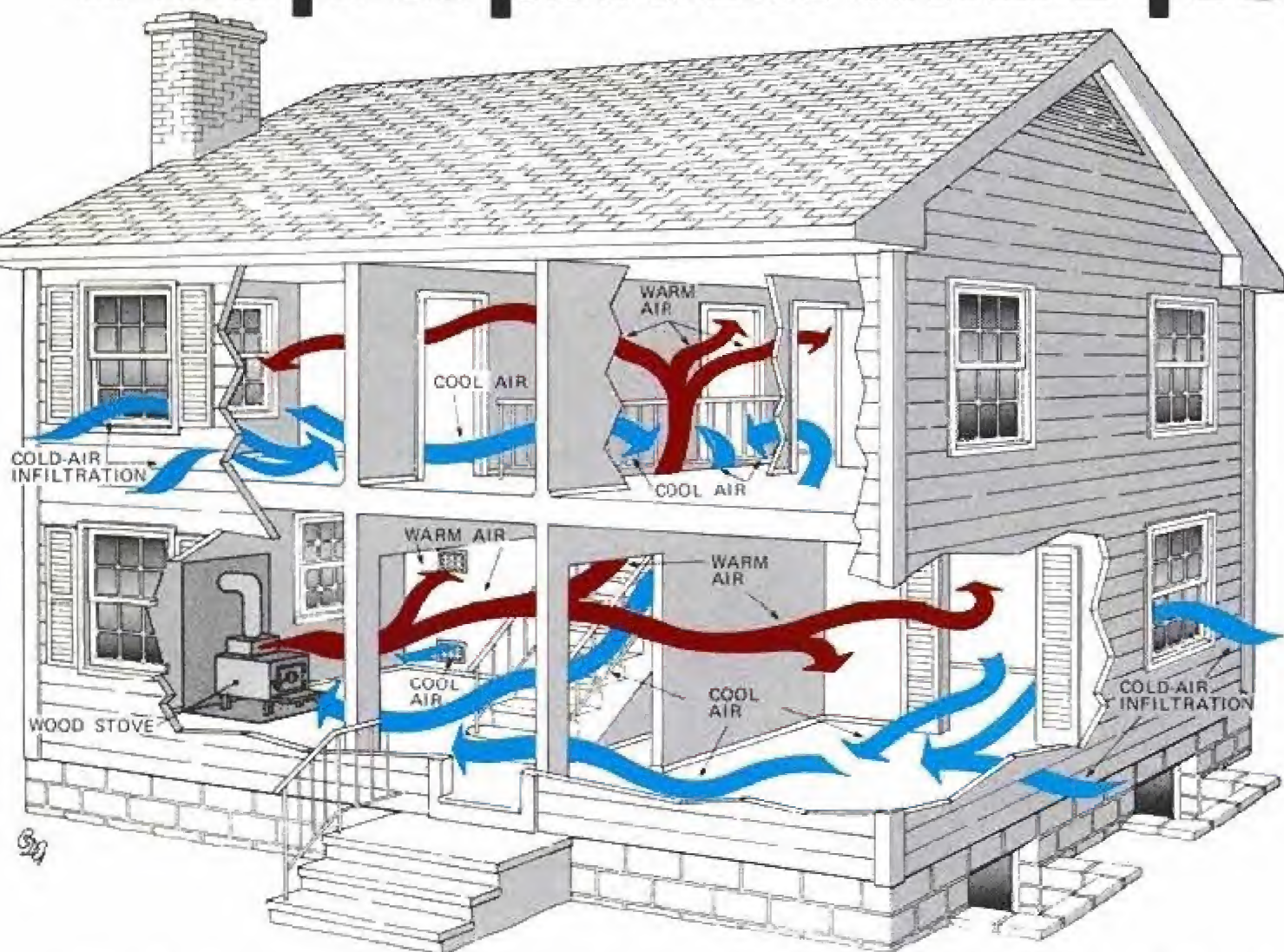


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5 ways to put heat where you



Don't heat the entire house when all you want is warmth in one or two rooms.

by John H. Ingersoll and Steve Willson

Consider the following reports of fuel savings by supplemental heater users:

A Portland, Me., family has an oil-fired, forced-warm-air furnace serving an air-duct system throughout the house. Last winter the furnace burned no oil.

A widow in Regina, Sask., weathered last winter with a central-heat system that used \$47 worth of electricity.

A fisherman in Malmo, Sweden, keeps most of his house at 50°F. through the winter and saves hundreds of dollars.

No one mentioned above shivers in icy rooms. Rather than pump money into a constantly burning central system, these people, like millions all over the world, chose to conserve their cash by deriv-

ing warmth from supplemental heaters.

Some, like the Portland family and the Regina widow, heat an entire house with a stove, as in the drawing above. This shows the real potential of larger capacity units. But sensible use of smaller units, like the Swede's radiant portable, can put a shot of heat just where you want it and render equally impressive results. Simple through-wall venting (as shown) is just one trick to heat another room without heating the whole house.

Three questions are usually asked about supplementary heat: 1. Does spot heat cut fuel costs? 2. How comfortable is "comfortable"? 3. Do you have to change your lifestyle? The answers:

1. It can. How much you save depends on how you use supplementary heaters. Wendell Stickney operates a wood stove with found lumber scraps and logs he cuts himself (see *The Art of Burning Wood to Get More Heat*, page 122, Sept. '80). The stove wipes out the need for all but \$50 worth of natural gas to fire a basement furnace occasionally. Stickney spends time to collect and cut wood, but out-of-pocket expenses include only the \$50 for

Supplemental heaters—like the stove above—keep your thermostat turned low, and offset the chilly blasts from cold-air infiltration. The idea is to use an auxiliary heater where warmth is wanted. Depending on the unit's capacity, you can heat one room or several as the arrows show.

heat and a modest sum for hot water. Conclusion: He saves plenty. His neighbors shell out \$800 to \$1,200 a year for heating fuel.

The Swede employs a portable electric-radiant heater to warm himself. When he moves to another room, he takes the heater with him. Does he save? Yes. His house is well fortified against Sweden's cold winters. A central heater operates only now and then to maintain 50°. And he's conservative in using the electric portable. At night it's off, as it is when the sun warms his breakfast table.

According to the Department of Energy (DOE), no formal long-term tests have been conducted on the energy-saving potential of supplemental heaters. But owners who have used stoves, wall furnaces and portables can prove savings.

want it-while using less energy

The key word, say all who were interviewed, is "use." Use central and localized heat with a shovelful of common sense and you'll save. Use it as if you were the King Midas of B.T.U.s, and you'll pay a king's ransom.

For example, a Long Island, N.Y., family installed a wood stove, hoping to beat the high cost of fuel oil. First fact: They



Jotul's cast-iron wood stove model No. 121 can put out 75,000 B.T.U./hr. with optional heat exchanger (uppermost section) or up to 49,000 B.T.U./hr. without an exchanger.

burned more wood than anticipated. Second: The price of wood in their Nassau County community rose last February to \$175 a cord. Savings? Zero. In fact, at winter's end their heating bills for wood and oil were more than last year's oil.

The family had bought the wood stove before pricing wood, and had not realized there was no place close by where they could cut and haul their own. Before you decide about changing fuel, use PM's chart on page 122. The chart provides a logical means for comparing fuel efficiencies, based on prices in your area.

2. "Comfortable" is a subjective word. A two-temperature electric blanket tells the story. She likes the dial set at six; he likes it at two. We all react to heat and cold in slightly different ways. But the answer for the family in Portland is "we're positively comfortable," and from Wendell Stickney is, "no problems. We're just as comfortable as we were with only central heat; maybe more so."

The answer for you again lies in the way you put central and localized systems to work. That leads to the answer for question 3.

3. Your lifestyle may have to change. In order to use supplementary equipment in a money-saving way, you may need to adapt to one or more of the following:

- Seldom-used rooms kept cold in winter.
- Cold rooms throughout the house from bedtime to breakfast.
- A chilly basement.
- Heat from a radiant unit that mostly warms the half of you facing the coils.
- New requirements for gathering, storing safely, and using unfamiliar fuels such as coal and kerosene.
- New concerns over the appearance of equipment and safety rules during operation.

Yet for those who have wisely chosen the right supplemental equipment and use it to best advantage, there are many more positives than negatives.

The family in Portland, operating a medium-sized wood stove on the first floor and a small wood stove in the second-floor bedroom area, claims there are no chilly rooms. Does it take time to find, fell, cut and store wood? Yes, but it also keeps husband and wife trim and healthy. Do they mind the appearance of the cast-iron stove in their living room? "No way. We think it's handsome. Besides, more people around here own stoves than don't."

Types of heaters

Five categories of fuel feed five different groups of supplemental (sometimes



Airtight King Radiant Coal Stove comes in three sizes, priced about \$290 to \$430, with manual draft controls and 24-gauge, aluminized-steel combustion chambers.



Dual Wattage (left) and Single Wattage Comfort Heaters from Edison are circulating portables with hidden 1,500-watt elements. "Stereo-speaker" cabinets stay cool.

called "space") heaters. Each group has advantages and disadvantages. Before buying, read the facts below. Then make your choice based on how well a heater suits your needs and the demands on your time.

One guideline applies to all five categories. Buy only equipment approved by a nationally recognized testing group. In most cases, this is the Underwriters' Laboratories. The official, UL-approved designation is "Listed by Underwriters' Laboratories, Inc." and the registered trademark is a small, encircled "UL."

This admonition applies to basic equipment—stoves and heaters—and to accessories such as flue pipes, connectors, wall sleeves, noncombustible base and wall protectors, as well as fire extinguishers.

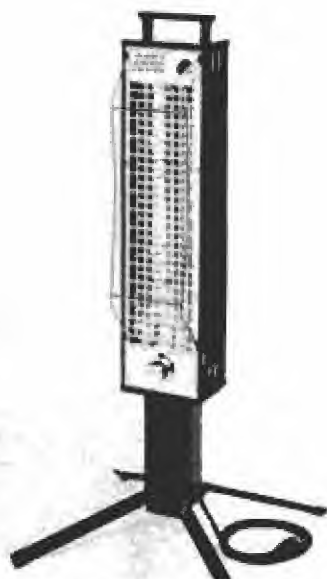
Wood

Little more than a decade ago, wood stoves were contraptions for hunting lodges and faraway farms. Today it's no longer unusual to see one sitting squarely in the middle of the living room of a city townhouse.

Sales of stoves have shot skyward and therein lies one problem. People totally unfamiliar with wood fuels (other than using wood for an occasional fireplace fire) are burning logs by the cord in stoves. Fire officials shudder at the thought, and point out that many winter fires (most, in some areas) start because of improperly installed or badly maintained wood stoves.

Since clear instructions for installing and using a wood stove are included with a new stove by every reputable manufacturer, one wonders why fires start. They do because there are among us a number who insist on "doing it their own way." The best advice from contented wood-stove users, manufacturers and fire officials: Heed manufacturer instructions to the letter. If some of the wording is unclear, get the dealer to explain. In fact, makers recommend that you ask the

dealer to visit your home to give you an idea of the best equipment for your space, where to put it and how to install it.



TPI's quartz heater model No. SRP-1 runs on 120 volts, puts out about 5,000 B.T.U./hr. It measures 36½-in. high with a 17×17-in. base and costs between \$40 and \$55.

If you must buy wood, price it before you buy a stove. When wood is on your property or nearby, an investment in a chain saw, wood splitter and ax will give you tools to cut it. Take time to learn how to use each.

Provided it is fired correctly, an airtight wood stove is tops in efficiency and heat production. Circulating stoves are a close second. Further down the line are potbelly, Franklin and box stoves, fireplace inserts and, further yet, free-standing fireplaces.

Prices range from about \$150 for small potbellies and box stoves to over \$1,400 for big airtights. Size influences price, and size is vital to your comfort. Prepared with cubic footage measurements in your house, discuss the connection between stove and house size with the dealer.

Coal

Rising in popularity much faster than makers expected, coal heaters are mini-versions of the furnaces grandfather and great-grandfather stoked in the basement.

Coal stoves resemble wood stoves more than other equipment. In fact, some

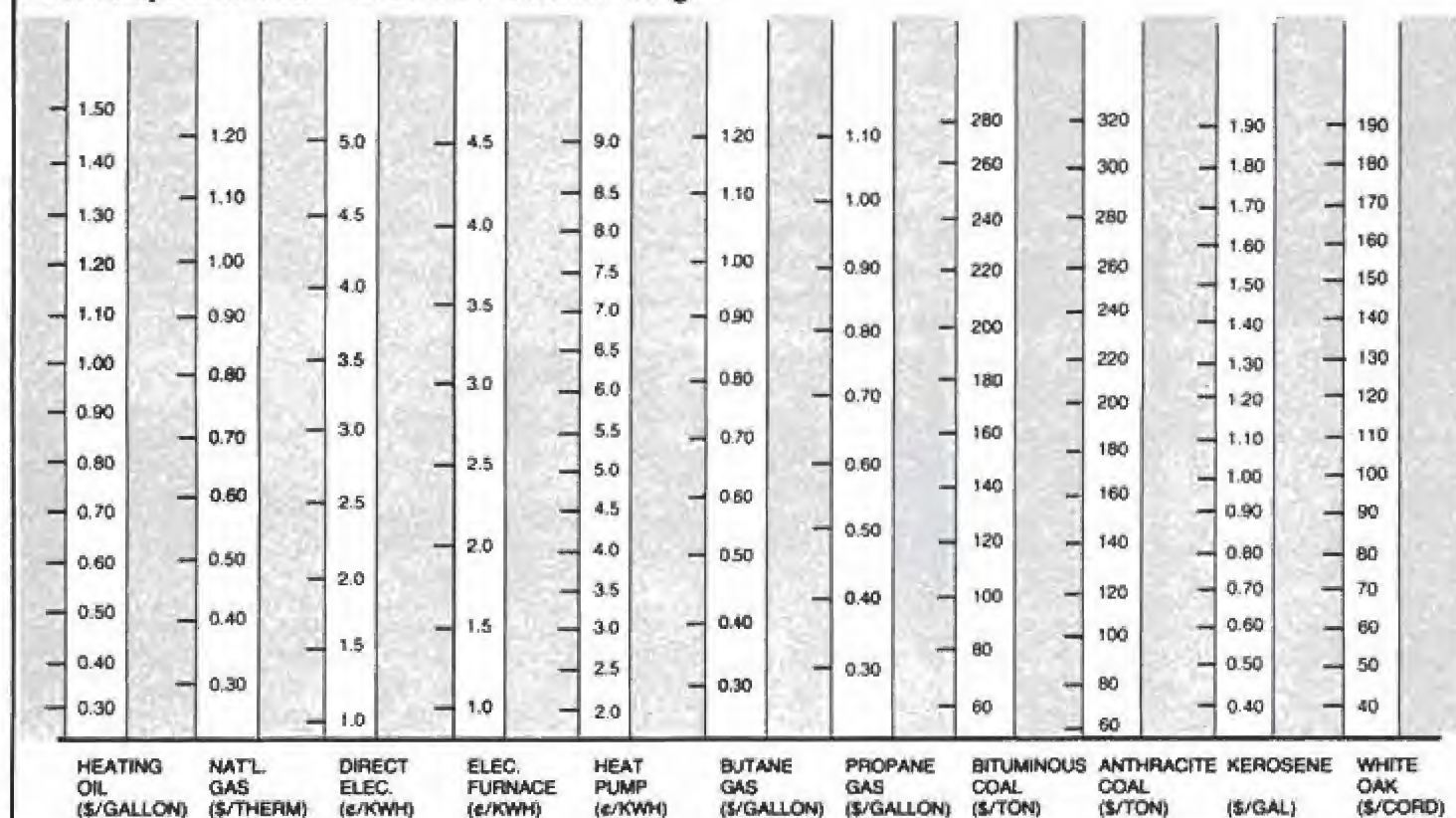


Thermo-Rador from Conservo is a portable, caster-mounted, electric, oil-filled radiator. With thermostat control, it can be set for 600, 900 or 1,500 watts; costs about \$140.

circulating stoves burn either wood or coal, although purists argue that dual-fuel stoves are never as good as single-fuel

(Please turn to page 126)

Fuel comparison chart: What will it cost to change?



Which fuel is the better value in your home town? Decide for yourself, using this chart. Gather a ruler, scratch pad, pencil and current costs from local fuel dealers. Here's how it works.

Suppose your furnace burns natural gas at 62 cents per therm. Through 0.62 in the natural gas column draw a horizontal line across the entire chart. Suppose further that you want to compare gas to fuel oil at \$1/gal. and electricity for baseboard heaters at 7 cents/kwh. The line you've penciled cuts the oil bar around 0.75 and the direct electricity bar around 2.6. Your conclusion? Natural gas is the best buy of the three. A fuel oil equivalent to gas at 62 cents/therm would have to

cost 75 cents/gal. and electricity would have to run 2.6 cents/kwh. Since prices in this example were \$1/gal. and 7 cents/kwh, neither is a bargain. Moving across the penciled line, even an energy-efficient heat pump would require current at 4.75 cents/kwh. on the pump's heating cycle to match the gas.

If you discover a fuel that proves a better value and want to switch, first add in the cost for the new equipment you'll need. Over a period of one or two years you still may come out ahead. Chart, based on fuel efficiencies, is compiled by Arthur W. Johnson of Arthur Johnson & Assoc., Gaithersburg, Md., and John H. Ingersoll.

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units. You'll discover if you buy a coal burner that installation and maintenance are practically identical to that for wood stoves.

Prices range in the \$275 to \$900 slot, and output depends on both use and type of coal burned. Currently the biggest problems are finding an adequate supply of the coal you want, storing it and disposing of the ashes.

Electricity

Wall- or ceiling-mounted bath heaters, either fan-assisted (convection) or radiant (like toaster coils) have been around since the 1930s. Added in the past

(Please turn to page 128)

The portables grow up: 2 new supplemental heaters

With nearly every cost of energy increase, supplemental heaters become more sophisticated. More people are looking for ways to save money and their heating bills are one of the first places they start. The resulting innovations and improvements on older ideas can be seen in these two heaters.

The Markel 3800 unit (right) is one of a new series of 13 heaters that can supply 2,250 to 8,530 B.T.U./hr. Running on 120 or 240 volts, they are direct-wired into your panel and have been designed for easy installation between studs. Their fans are quiet and newly designed nickel chromium elements are suspended on individual ceramic supports. Thermal cutouts prevent overheating and a foldout control panel maintains a clean appearance.

To our knowledge, Kero-Sun's Monitor 20 (far right) is the first vented kerosene heater ever offered in this country. Testing of this new unit is under way and it is expected to have UL approval before the end of the year. Its output runs between 7,100 and 18,000 B.T.U./hr. and it must be installed next to an outside wall for the 2½-in.-diameter vent. The

cost will be about \$850, not including a bulk storage tank. But the heater-mounted-tank can be filled daily, if you choose.

Its controls represent some new technolo-

gy in this field. Featured are on-off timing mechanisms, temperature sensor, indicator lights for refueling and an automatic shutoff to put out the flame if malfunction occurs.



Markel's 3800 (left) and Kero-Sun's Monitor 20 are well suited as a primary heat source in room additions and basement and garage conversions. They can deliver plenty of heat and are easily installed.

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The Kero-Sun Monitor 20[™] is 70-80% more efficient than wood or coal stoves.

You probably already know that you could save money by installing a vented heater in your home and turning down your central heating system.

What you may not know is the Kero-Sun Monitor 20 kerosene heater is 70 to 80% more efficient than the average wood or coal stove. Wood or coal stoves draw warm air from your room and send it up your chimney. The Monitor 20 uses only outdoor air for combustion. Then, it heats your room air and *circulates* it out



into the room. The Monitor 20 can keep a large 26' x 25' area at an even comfortable temperature,

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Every Monitor 20 is engineered for safety and is listed by Underwriters Laboratories.®

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nient than wood or coal stoves. There's no wood to chop, or coal to haul. And no smoke, sparks, ashes or soot to worry about.

For a full color brochure and the name of the Monitor 20 dealer nearest you, write to: Mr. Frank Lopez, Kero-Sun, Inc., Dept A, Box 549, Kent, Ct. 06757

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7:23 A.M.



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*Models SP-DX, 17-DK, 22-DK are U.L. Listed. Check local codes for permitted use. The manufacturer reserves the right to make product modifications without notice.

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decade are quartz heaters (radiant) and units that perform like the radiators in a hot-water system. These are single, portable units filled with water or a light oil. The fluid is heated electrically by plugging in the heater. The fluid conveys the heat to the metal which radiates it to you.

All four types are portable. The first three are also available as built-ins. Operated in the way employed by the Swedish fisherman, electric space heaters can conserve fuel for your central system. However these units are people and room heaters at most. Outputs range from 3,000 to about 18,000 B.T.U./hr., far short of a whole-house requirement, which is in the 50,000 to 120,000 B.T.U./hr. range.

Prices are commensurate with performance. The low figure hovers around \$30; rarely do electric units exceed \$200.

Kerosene/oil

Nearly all kerosene heaters are portable (an exception is shown on page 126), even more portable than the electric units since their operation requires no cord or outlet. All are radiant, sending warmth



Temp-Rite 7 kerosene heater from Aladdin has a top output of 7,800 B.T.U./hr., an automatic shutoff, 8-gal. fuel capacity and battery-operated ignition.

essentially to you rather than spending time heating the air. They are not vented and for that reason makers recommend the introduction of fresh air to the space being heated. A rule of thumb suggested by the Consumer Product Safety Commission is 1 sq. in. of fresh air opening for each 1,000 B.T.U. of heater output.

Kerosene units generate between 7,000 and 18,000 B.T.U./hr. and generally cost between \$85 and \$300. Like electrics, they heat both people and rooms. Because of the open flame, be sure to observe all the maker's safety tips.

No. 2 oil and kerosene are hardly distinguishable. In fact, some suppliers offer them interchangeably. Yet, the typical equipment for the two is different. So-called oil heaters are nearly always installed on an outside wall and all of them are vented. As with gas heaters, they are



Montgomery Ward's vented, gas-heater model No. 23805 can be outfitted for either natural or LP gas. It has a 75,000 B.T.U./hr. capacity and costs about \$470.

somewhat more popular in the South, since their output ranges from around 35,000 to 70,000 B.T.U./hr., more than enough heat for mild winter conditions in a house up to 1,500 sq. ft. in size. One group of smaller models costs from \$150 to about \$300. Models generating up to 70,000 B.T.U./hr. can run up to \$1,000.

Gas

Equipment using natural or LP gas is not portable. These heaters are attached to or built into a wall; they're most popular where winters are mild, since they provide heat quite easily for a modest-size house. Outputs range from 15,000 to 70,000 B.T.U./hr. Most units deliver convected heat, but some combine convection and radiant heat.

Major among the byproducts of gas combustion is carbon monoxide, deadly in even small quantities. For that reason, most gas wall heaters are vented to the outside. Even so, it's wise to clean the burner periodically and provide some fresh air for the space being heated. Prices for vented units are \$200 to \$650.

Prices for unvented gas heaters range from \$100 to \$250, and are a lure for anyone anxious to save cash. Although the American Gas Assn. has approved some models, a few areas have prohibited their sale for safety reasons.

Though you can save some money installing a gas heater on your own, as a rule, the gas hookup must be made by a gas-company serviceman. Follow the maker's instructions closely for installation and maintenance. **PM**

SOURCE LIST

For a list of supplemental heater manufacturers, consult the following associations:

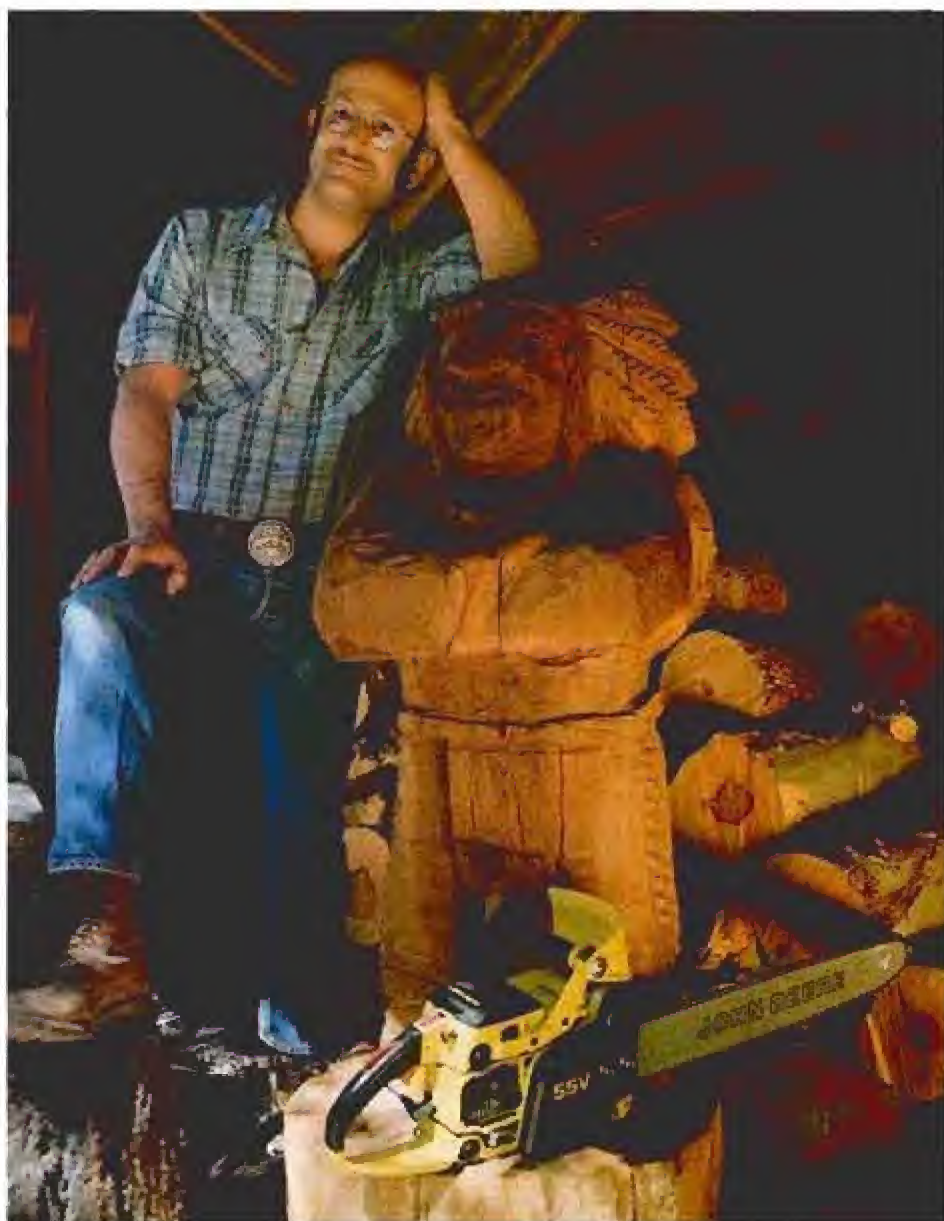
Wood Heating Alliance, 111 East Wacker Dr., Chicago, Ill. 60601 (for wood and most coal).

National Electrical Manufacturers Assn., 2101 L St. NW, Washington, D.C. 20037 (for permanently installed electric units).

Assn. of Home Appliance Manufacturers, 20 North Wacker Dr., Chicago, Ill. 60606 (for portable cord-operated electric units).

National Kerosene Heater Assn., 2017 Walnut St., Philadelphia, Pa. 19103 (for kerosene heaters).

Gas Appliance Manufacturers Assn., 1901 North Fort Myer Dr., Arlington, Va. 22209 (for LP and natural gas).



I farm for a living. I just saw for fun.

When I bought this John Deere Chain Saw, I told everyone I needed it to help with my chores. And it has come in handy for trimming fruit trees and cutting firewood.

But the real reason I got it was to pursue my career as an artist.

You see, when I'm not farming, I use my John Deere Chain Saw to carve sculptures out of wood. I've made totem poles, heads of famous people, furniture, you name it.

And for turning hunks of wood into works of art, nothing handles quite like a John Deere Chain Saw.

It's easy for me to control, and it hasn't given me trouble even once.

That's important when you consider I do most of my art work after working eight or ten hours in the field. In fact, I like it so much, my next sculpture just may be a self-portrait. Of the chain saw.



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John Deere has seven Chain Saws, with guide bars from 10 to 27 inches. For a free folder, write John Deere, Dept. 52, Moline, IL 61265.

Energy-saving ideas that work for readers

The family warming-room

My family and I lived in a large, uninsulated farmhouse in a cold and windy part of Pennsylvania. It certainly wasn't an energy-efficient home. Yet we still were able to do much to save heating fuel:

■ We closed off the top floor of the house and tried to seal up the living room where our old, inefficient oil heater was. This way, we had some place to go that was reasonably warm. While we were away during the day, we let the house get down to 45° F. When we got home, we turned on the heater and in 15 minutes, the living room was comfortable. The upstairs stayed pretty cold and acted as 8 ft. of dead-air space.

■ We concentrated our activities in the one large room, and gained the heat of the lights and the TV there. The chairs were cushioned to help insulate our bodies. We covered the windows with heavy drapes to keep the heat in, and we put extra rugs on the floor to act as insulation. We wore wool slacks and slippers, long johns and wool sweaters in the house.

■ When it got too cold for comfort, we did exercises. This was probably the most important step. Twenty push-ups will really warm up a cold body. At night, we let the house get cold and used extra blankets or an electric blanket on low.

Since then, we've built our own well-insulated home. Now it's so easy to stay warm that we've quit exercising. Nor do we gather in the same room as often. I miss the warmth the cold brought us.

—Stephen M. Kennedy, Orrtanna, Pa.

Bottle the sun

As an antique bottle collector, I have always displayed my prized bottles in the many windows on the south side of my house. The sunlight passing through them brings out the full beauty of the old glass. Three years ago, when I became concerned with the energy crisis, I began filling the bottles with water, starting in November. Since then, I've noticed that the winter sun warms the water and the bottles remain quite warm several hours after the sun has gone down. Thus, in a small way I've converted my collection into an energy-saving solar collector.

—LeRoy J. Hebert, Lexington, Mass.

Washer for washing

Here's how I fixed our shower so that we save nearly half the amount of hot water we used to use when taking showers. I unscrewed the shower head and inserted a washer with a small hole in it into the head. After replacing the head and turning on the shower, I got the same amount of pressure, but less water coming out of



"When it got uncomfortably cold, we exercised in the warming-room. By February, I was doing 80 push-ups per session, enough to keep me toasty warm for two hours or more."

the head. I also saved the cost of an energy-saving shower head.

—Steve H. Hoffmann, Rockford, Ill.

Money-saving storm door

I saved the cost of a patio storm door (priced from \$125 to \$250) by making a \$25 version, using 8-mil-thick clear polyethylene, four 2×4s, staples and four, flat corner irons with screws. I made a frame of the 2×4s which fit snugly into a lip on the exterior surface of the patio door frame. I mitered the joints neatly and secured them with the corner irons. Then I stapled the plastic to the frame.

—Dennis Cardarella, New Berlin, Wis.

Filling the gap

Perhaps you can use this idea to keep your basement warmer this winter without turning up the thermostat. Inspect the spot in the basement where the chimney goes through the ceiling to the first floor. If there is an open gap between the house framework and the chimney, warm air is escaping up this chimney shaft and coming out in your attic. Stuff the opening around the chimney with fiberglass insulation to seal it. You will find, as I did, that your basement will remain warmer.

—Norman Dolak, Lindhurst, Ohio

Insulating drafty outlets

Insulating drafty electrical outlets is another way to cut fuel consumption. An inexpensive way of doing this is by making an insulator of a common Styrofoam meat tray. Remove the electrical outlet cover from the wall and use it as a template, making the foam insulator slightly smaller than the cover so it will fit inside, yet completely cover the rough opening.

For a neater fit, tilt the knife you are using and bevel the foam edges. Punch a screw hole, using an ice pick or an awl. (An ice pick makes a smoother, tapered hole.) If your insulator is too thick, you can flatten it with a rolling pin. Rolling it will flatten the foam; it won't increase overall dimensions. Finally, replace cover and check for drafts.

—Wayne Rivers, Sanborn, N.Y.

Warmed-up garage

When it gets bitterly cold here in northern Wisconsin, I still like to use my heated garage. However, the wind used to whistle through it so much I could almost see the fuel dollars whistling out. I solved the problem by applying insulation and siding to the outside of my 16-ft. overhead garage door. The job took three, 4×8 sheets of aluminum siding; two and one-half, 4×8 sheets of ¾-in. Styrofoam; some ¾-in. furring strips, a polyethylene vapor barrier and nails. I spent about eight hours and \$40.

First, I tacked the vapor barrier to the exterior of each of my door panels. Then I nailed the furring strips around the perimeter of each panel and set the insulation within these "forms." Finally, I covered each panel with aluminum siding. I didn't have to adjust my door for clearance, but if you do, it might only be a matter of moving out the trim that's on your jambs. The insulation made quite a difference in controlling drafts and retaining heat.

—LaMonte Radwanski, Barron, Wis.

Share your home energy-saving ideas. PM will pay \$25 for each published idea. Include sketch or photo, if necessary, and a stamped, self-addressed envelope if you want unused material returned. Send to Energy-Saving, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019



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PM

Energy-saving lighting proves more is less

New lights deliver the same brightness as—or more than—equivalent incandescent bulbs, at lower cost.

by John H. Ingersoll

Where can you buy more for less these days? One bright answer rests with new lighting products, where you can find a better deal than putting your money into standard incandescent bulbs.

Here's a quick rundown on the advantages of these new products (though not all deliver all the advantages).

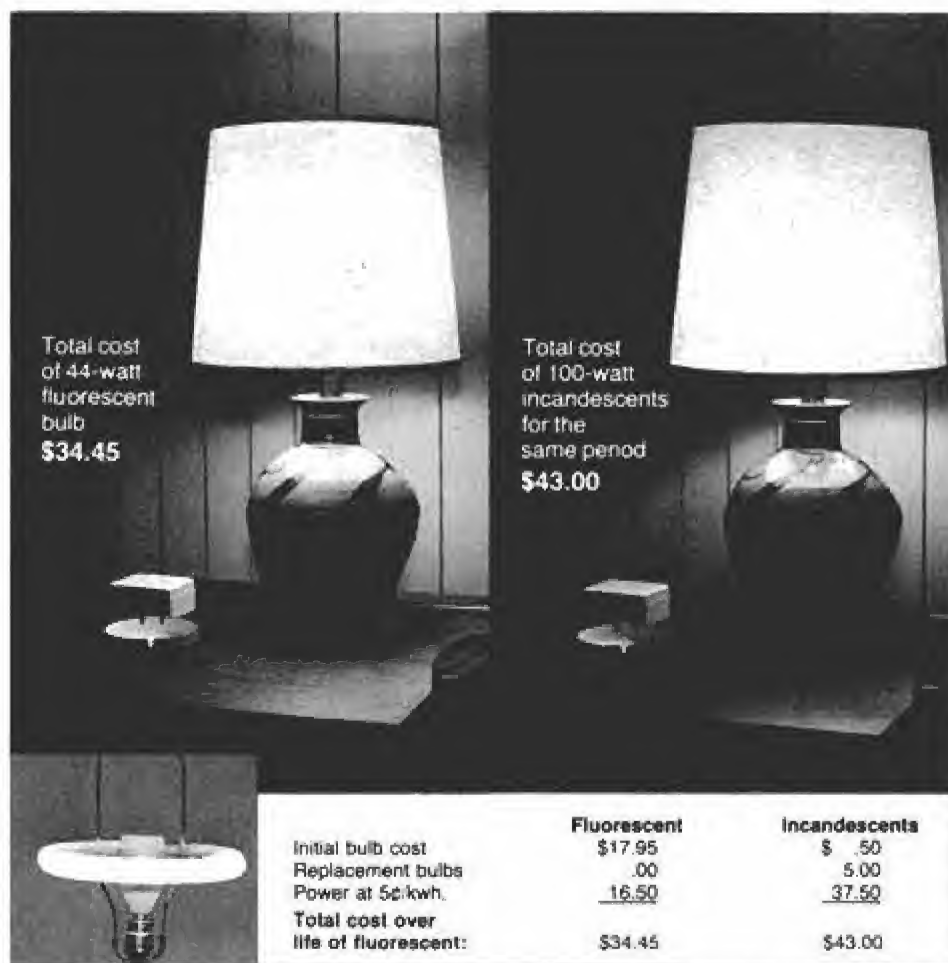
- You gain more light for less money.
- These sources deliver illumination over a longer period of time—sometimes over 25 times as long, and are therefore more convenient to use.
- With new sources in place, the electric meter spins more slowly.

If all this is true, why isn't everyone rushing out to buy? For three reasons: 1. The initial cost is higher than what you pay now for standard incandescent bulbs; 2. for pin-contact fluorescent tubes, you may have to buy a fixture as well; 3. it's likely you'll have to search beyond the supermarket to locate the right "color" fluorescent tubes or one of the newer, energy-saving offerings described here.

However, the picture is slowly changing. Distribution of the newest items ought to be more widespread soon. If you can't find what you want, write to the manufacturer. Addresses are listed on page 138.

Table-lamp fluorescents

Now you can simply toss out a spent incandescent bulb from that end-table lamp and screw in a fluorescent. As the photos above show, illumination is every bit as good using a fluorescent—if not better. You're also due cash savings in two ways: There's less draw on your electricity with a fluorescent; its long life will cut your bulb bill.



Comparison of GE's Circulite fluorescent (above, left and inset) with a standard 100-watt incandescent (above right): The fluorescent sheds as much light for less money.

Fluorescence demands only a small amount of electric power before it's aglow. For example, in a year-long comparison, assuming lights are on in the house for about five hours a day (roughly normal), Duro-Lite matches one 40-watt Vita-Lite fluorescent against two 75-watt incandescents. Over the 365 days, the two incandescents burn up \$16.43 worth of energy, while the fluorescent consumes a mere \$4.38—both figures based on a moderate rate of 6 cents per kwh.

In this example, there's a bonus. The two bulbs, burning at a 150-watt rate, produce 1,980 lumens (standard measure of light output). The 40-watt fluorescent tube delivers 2,180 lumens.

(Note: A 40-watt fluorescent in use actually draws 54 watts, the difference made up by electricity demand for the ballast—a device that controls voltage, wave pattern and current delivered to the vapor within the near-vacuum tube. The \$4.38 figure above is based on 54 watts.)

During the same year's period, a number of incandescents (note plural) will cost more than a fluorescent (note singular). How much more? Lithonia Lighting did a study based on 1980 retail prices. Two 60-watt incandescent bulbs were tagged at \$1.62, while a lumen-equivalent circular fluorescent of 32 watts (35-watt total with ballast) was \$8.85.

During the year those incandescents kept burning out. Replacements ran up a

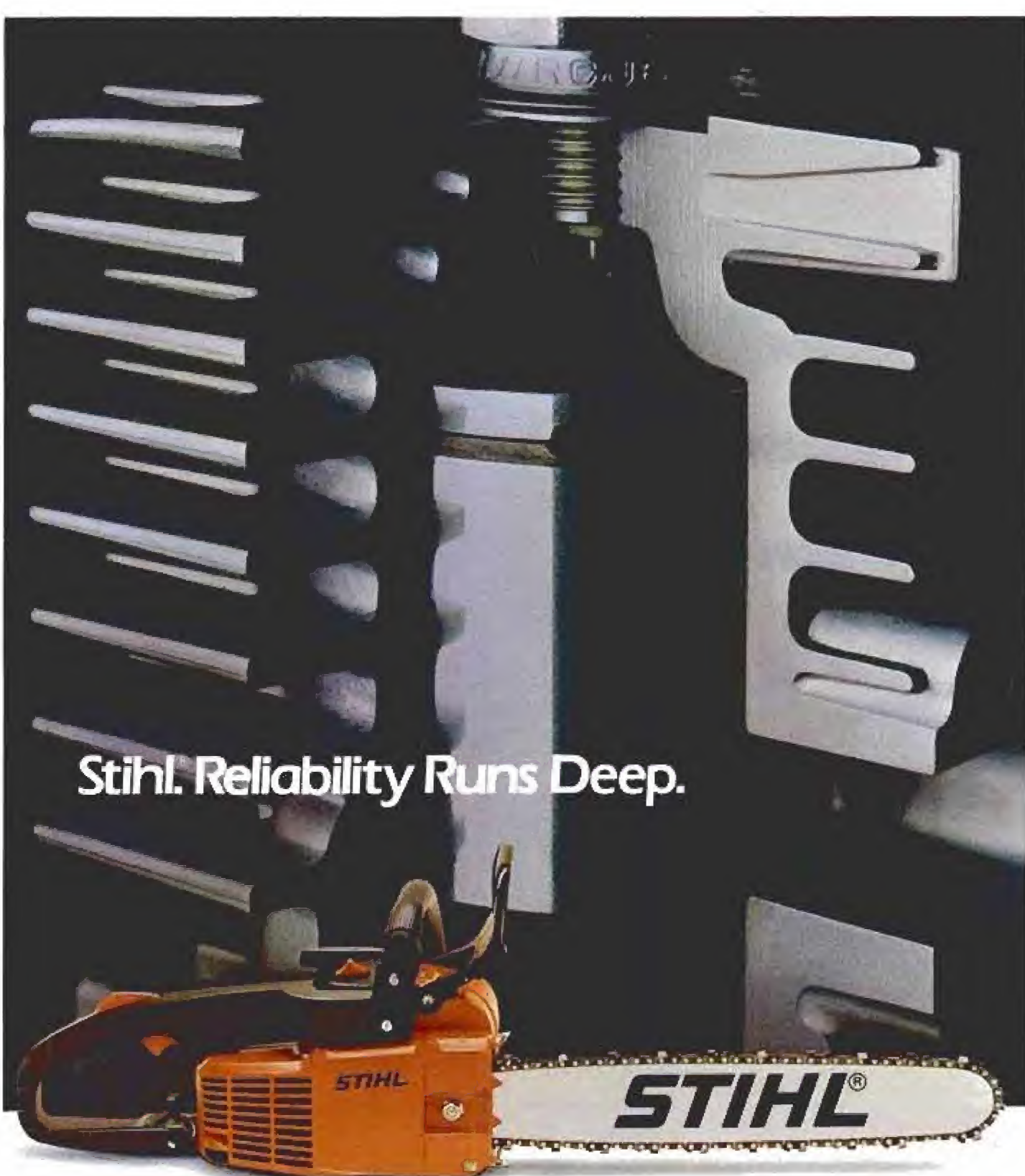
bill of \$17.82. The fluorescent continued to work. As with the Duro-Lite test, figures were based on average home use of light. The final score: incandescents—\$19.44; fluorescent—\$8.85, a saving of \$10.59.

At the heart of the new table-lamp fluorescents is a redesigned ballast, small enough to screw into the existing socket. Over the ballast shaft slides the fluorescent unit. Once in place and reshaded, the lamp operates the same. The difference: The light just lasts and lasts.

Three major producers, General Electric, Sylvania and Westinghouse, have introduced table-lamp fluorescents. GE and Sylvania offer an adaptation of the circular fluorescent introduced in the 1940s (and still available), a dinner-plate-diameter tube that often found its way to the kitchen ceiling. Westinghouse developed a U-shaped, mini-fluorescent packed into a tube not vastly different from an incandescent bulb.

For three-way fixtures, GE offers a two-way fluorescent delivering the brightness level of a 50-watt and 100-watt incandescent, but doing it on 16 and 44 watts. The company also produces similar units at one-level brightnesses of 60 watts (actual 22 watts), and 100 watts (actual 44 watts). At 22 watts, Sylvania's entry puts out 75-watt brightness and Westinghouse's small tube throws out light of 60 to 75 watts on a demand of 27 watts.

One of these five new fluorescents



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It's manufactured in such a way that the cylinder walls actually retain oil. So they stay smoother. Longer. Providing better cooling, lubrication, and

more power output. Which is another reason this Stihl 011AV is just getting broken in when most other saws are breaking down.

After all is said and done about chain saws, one simple truth comes through. You get what you pay for.

For your local dealer's name, call toll-free 1-800-528-6050, Extension 1430. In Arizona call 1-800-352-0458, Extension 1430.

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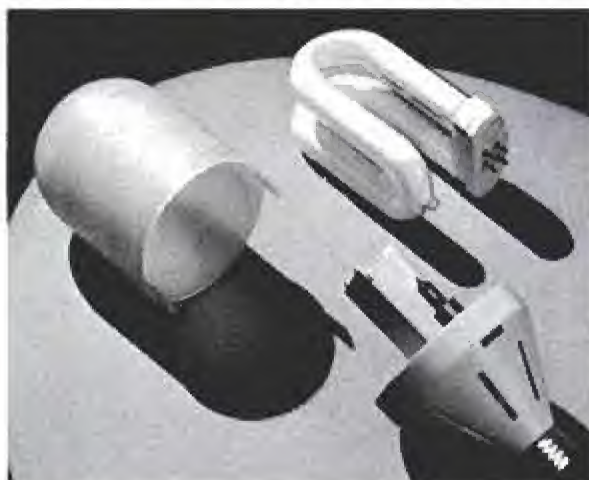
ought to fit just about any standard-size socket in your home, including wall sconces and ceiling fixtures. Replacing every bulb in an average three-bedroom house could bring year-end savings of \$200 to \$400.

Read the fine print, though. For example, GE warns you not to close in its two-way tube with a frosted glass-covered ceiling fixture or globe-shaped swag light. Heat buildup within the confined space could knock out the tube.

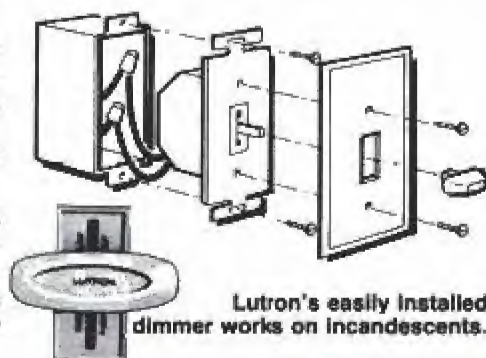
A subtler reason than inconvenience has kept fluorescents out of living areas for years. "Colors look crazy under that light," say many who have tried them. This is partly true. Under the harsh light of cool white fluorescents, a bright fire-engine-red pillow could look almost gray. People tend to look wan and unhealthy.

Unfortunately, not many know there are more "colors" than cool white. Recognizing the problem, all three makers produce table-lamp fluorescents in a "soft white" rendering, which makes clothes, food and you look more the way you expect.

Yet the cool-white conventional unit remains for anyone wishing to buy fluorescent tubes in 20-, 30-, or 40-watt sizes. Savings easily equal, and sometimes exceed, those you reap with the new



A tough acrylic cover wraps the Westinghouse fluorescent and its compact, instant ballast. The cover fits as handily as an incandescent bulb into a globe fixture.



Lutron's easily installed dimmer works on incandescents.



Norelco's sodium outdoor light spreads bright yellow light for one-quarter acre.

COMING ATTRACTIONS

Perhaps before the year is out, and easily next year, three new replacements for incandescent bulbs could overshadow the advantages of the table-lamp fluorescents.

One each from General Electric and Sylvania are classified as metal halide. The third, from Norelco, is termed a low-pressure mercury-vapor source, which reacts with rare-earth fluorescent powders located inside the discharge tube.

The metal-halide light is from radiation of a metallic vapor (generally mercury) and products of halides (generally rare earths such as thallium or indium). Similar to the new fluorescents described elsewhere, these bulbs operate with the aid of a miniaturized ballast.

GE's entry, called Electronic Halarc, will burn with the brightness of the top setting on a standard 50/100/150-watt, but at an energy-squeezing 55 watts. The bulb is said to burn for 5,000 hours and will probably cost about \$10.

Sylvania's new bulb, called Miniarc, is a 40-watt, with illumination equal to 100 watts. It's incandescent, has an expected life of 4,500 hours and a price somewhere between \$12 and \$15.

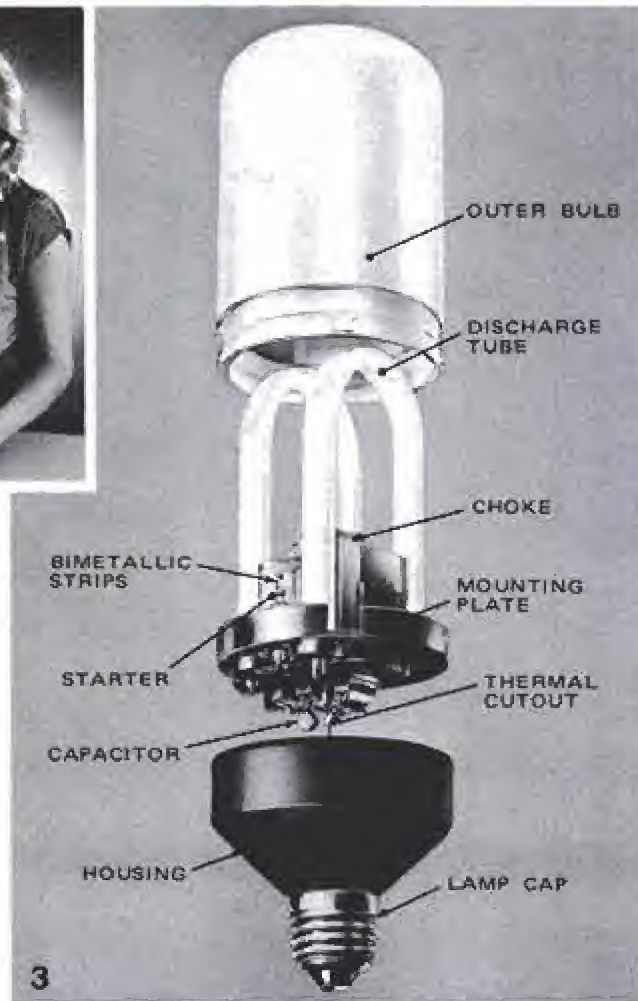
Statistics on the Norelco bulb, simply labeled SL, are: 18 watts to do the work of a standard 60-watt incandescent. It lasts 7,500 hours and is priced at around \$12.

Norelco expects to introduce 9-, 12- and 26-watt bulbs to replace 40, 50 and 75 watters respectively. GE and Sylvania also plan other wattages.

1 Cutaway of GE's Electronic Halarc reveals electronic controls in the base and an arc tube in the bulb.

2 Sylvania's Miniarc is 40 watts with the illumination level equal to that of a 100-watt incandescent bulb.

3 Norelco's SL comes with a coated, or a clear, prismatic outer bulb.



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Our unique wood-to-coal conversion unit. The Vermont Castings Vigilant and Resolute are designed to burn either wood or coal with equally high efficiency. Our advanced thermal engineering and unique "stove within a stove"™ design make it possible.

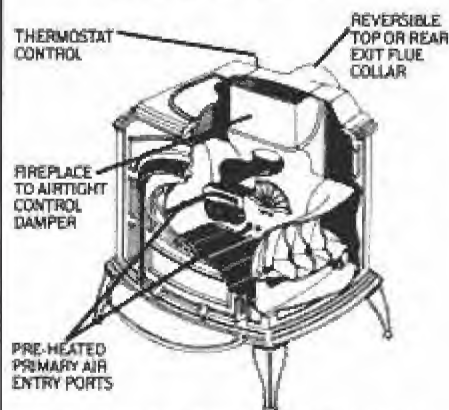
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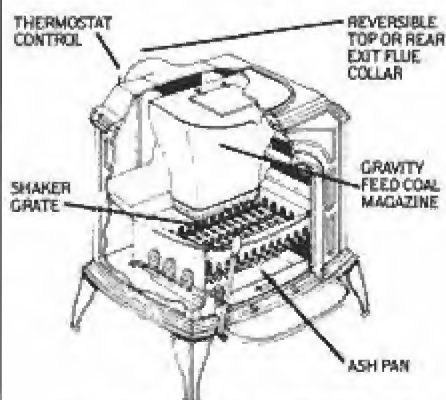
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table-lamp units. Fixture makers have also designed attractive new covers for ceiling-mounted fluorescents.

Manufacturers of incandescents are also redesigning for efficiency. From GE and Westinghouse come three-way bulbs at 15/135/150 watts, replacing the conventional 50/100/150 watts. The concept: Who needs 50 watts for conversation, watching TV, or as a security light when 15 watts will do? Because of a redesigned tungsten coil, the 135-watt setting produces 8 percent more light than the 150-watt level on the older bulb.

Need a close-up light for shop, study or as an accent on a piece of art? GE recently introduced a watt-saving reflector bulb. This 50-watter is housed in its own swivel fixture for around \$11. Because the light is concentrated, the subject is illuminated as much as it would be by a standard 100-watt bulb.

Sylvania has joined the energy-saving clan with four bulbs at slightly less wattages than standard. For example, it offers a 69-watter to do the work of an ordinary 75-watt bulb.

Floodlamps for outdoor safety and security are effective, but they eat up energy dollars.

Lighting strategies that save energy



Low-watt fluorescents from GE placed under kitchen cabinets (above) serve as security lights. Built-in downlights from Duro-Lite (right) reflect off glass and mirror back into the room.



However, Norelco offers a low-pressure sodium light that will economically illuminate up to one-quarter acre, or 10,000 sq. ft. There is a yellow cast to the light, but if safety and security are concerns, this fixture is a good investment.

Light dimmers help you chip away at your electric bill and lengthen bulb life. Incandescent light dimmers are simple to

install. One type replaces a wall switch; another cuts into a fixture cord and a third kind wires to an existing table lamp. Prices are \$5 to about \$25.

Fluorescent dimmers work only on standard 30 to 40-watt, rapid-start fluorescent tubes. In addition, each tube must have a special ballast to replace the orig-

(Please turn to page 138)

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Kit converts a 55 gallon drum (not supplied) into a high capacity wood burner. Features large 13 1/4" square door opening, cam-lock door catch, and spark-proof design. Patented internal draft channel, draft control, and airtight design allow controlled, efficient heat, while limiting metal temperatures of barrel to prevent burnup.

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Thousands in use by U.S. Army, Navy, Depts. of Nat. Resources, Agriculture, Federal, state and local government agencies.

Sotz Corporation, 13643 Station Rd., Columbia Station OH 44028

ANNUAL LIGHTING COST COMPARISON

WATTS	KILOWATT HOUR (KWH) COST RATE (¢)																
	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
15	1.31	1.64	1.97	2.29	2.62	2.95	3.28	3.60	3.93	4.26	4.59	4.91	5.24	5.57	5.90	6.22	6.55
25	2.18	2.73	3.28	3.82	4.37	4.91	5.46	6.01	6.55	7.10	7.64	8.19	8.74	9.28	9.83	10.37	10.92
35	3.06	3.82	4.59	5.35	6.12	6.88	7.64	8.41	9.17	9.94	10.70	11.47	12.23	12.99	13.76	14.52	15.29
40	3.49	4.37	5.24	6.12	6.99	7.86	8.74	9.61	10.48	11.36	12.23	13.10	13.98	14.85	15.72	16.60	17.47
60	5.24	6.55	7.86	9.17	10.48	11.79	13.10	14.41	15.72	17.04	18.35	19.66	20.97	22.28	23.59	24.90	26.21
75	6.55	8.19	9.83	11.47	13.10	14.74	16.38	18.02	19.66	21.29	22.93	24.57	26.21	27.85	29.48	31.12	32.76
80	6.99	8.74	10.48	12.23	13.98	15.72	17.47	19.22	20.97	22.71	24.46	26.22	27.96	29.70	31.45	33.20	34.94
90	7.86	9.83	11.79	13.76	15.72	17.69	19.66	21.62	23.59	25.55	27.52	29.48	31.45	33.42	35.38	37.35	39.31
100	8.74	10.92	13.10	15.29	17.47	19.66	21.84	24.02	26.21	28.39	30.58	32.76	34.94	37.13	39.31	41.50	43.68
105	9.17	11.47	13.76	16.05	18.35	20.64	22.93	25.23	27.52	29.81	32.10	34.40	36.69	38.98	41.28	43.57	45.86
135	11.79	14.74	17.69	20.64	23.59	26.54	29.48	32.43	35.38	38.33	41.28	44.23	47.17	50.12	53.07	56.02	58.97
150	13.10	16.38	19.66	22.93	26.21	29.48	32.76	36.04	39.31	42.59	45.86	49.14	52.42	55.69	58.97	62.24	65.52
160	13.98	17.47	20.97	24.46	27.96	31.45	34.94	38.44	41.93	45.43	48.92	52.42	55.91	59.40	62.90	66.39	69.89
175	15.29	19.11	22.93	26.75	30.58	34.40	38.22	42.04	45.86	49.69	53.51	57.33	61.15	64.97	68.80	72.62	76.44
200	16.94	21.84	26.20	30.58	34.94	39.32	43.68	48.04	52.42	56.78	61.16	65.52	69.88	74.26	78.62	83.00	87.36
215	18.78	23.48	28.17	32.87	37.56	42.26	46.96	51.65	56.35	61.04	65.74	70.43	75.13	79.83	84.52	89.22	93.91
250	21.84	27.30	32.76	38.22	43.68	49.14	54.60	60.06	65.52	70.98	76.44	81.90	87.36	92.82	98.28	103.74	109.20
300	26.20	32.76	39.32	45.86	52.42	58.96	65.52	72.08	78.62	85.18	91.72	98.28	104.84	111.38	117.94	124.48	131.04

Using this chart, you can determine the cost of lighting your home. First, list all of the light bulbs in your home, each with wattage. Determine the approximate number of hours each is used during a 24-hour

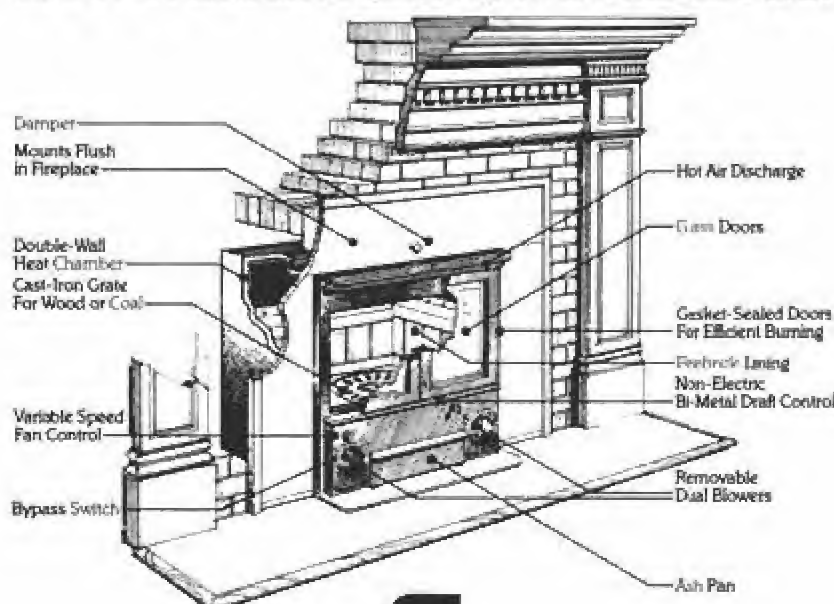
period. Find the column corresponding to your utility rate. Extract the figure in that column on line with the wattage of the first bulb. It is a dollar figure for 12 hours of use, seven days a week for a year. If you

estimate use at five hours daily, multiply it by $\frac{1}{2}$. Repeat the calculation for all bulbs. Total the figures to find the yearly cost.

Chart adapted from North American Philips Lighting Corp

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HOME ENERGY GUIDE

inal one. Price of the ballast: about \$30. The dimmer, which costs \$40 to \$50, works on one or up to 30 fluorescents.

Savings do accrue using any dimmer. Suppose you consistently burn a 100-watt incandescent at 70-percent capacity. That results in a 17.5-percent saving in electricity, which translates to \$3.06 at 6 cents per kwh, for the average year, not including added life of the bulb.

Common sense suggests other ways to trim your bills; for example, dining by candlelight and chatting by firelight. What could be nicer? **FM**

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Westinghouse Electric Corp., Lamp Div., Bloomfield, N.J. 07003

Fluorescents

Duro-Lite Lamps Inc., 17-10 Willow St., Fair Lawn, N.J. 07410

General Electric Co.
GTE Products Corp.
Westinghouse Electric Corp.

Metal halide-type sources

General Electric Co.
GTE Products Corp.
North American Philips Lighting Corp., Norwalk, Hightstown, N.J. 08520

Low-voltage fixtures

Progress Lighting, Subsidiary of Kidde, Erie Ave. and G St., Philadelphia, Pa. 19134

New fluorescent fixtures

Halo Lighting Div., McGraw-Edison Co., 400 Busse Rd., Elk Grove Village, Ill. 60007
Lithonia Lighting, Box A, Conyers, Ga. 30207
Progress Lighting, Rangaire Corp., Box 177, Cleburne, Tex. 76031

Thomas Industries, Box 1643, Louisville, Ky. 40201
Lightolier Inc., 346 Claremont Ave., Jersey City, N.J. 07305

Dimmers

General Electric Co.
Lutron Electronics Inc., Cooperburg, Pa. 18036

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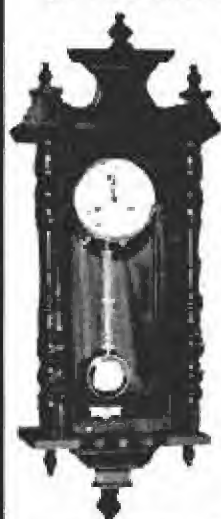
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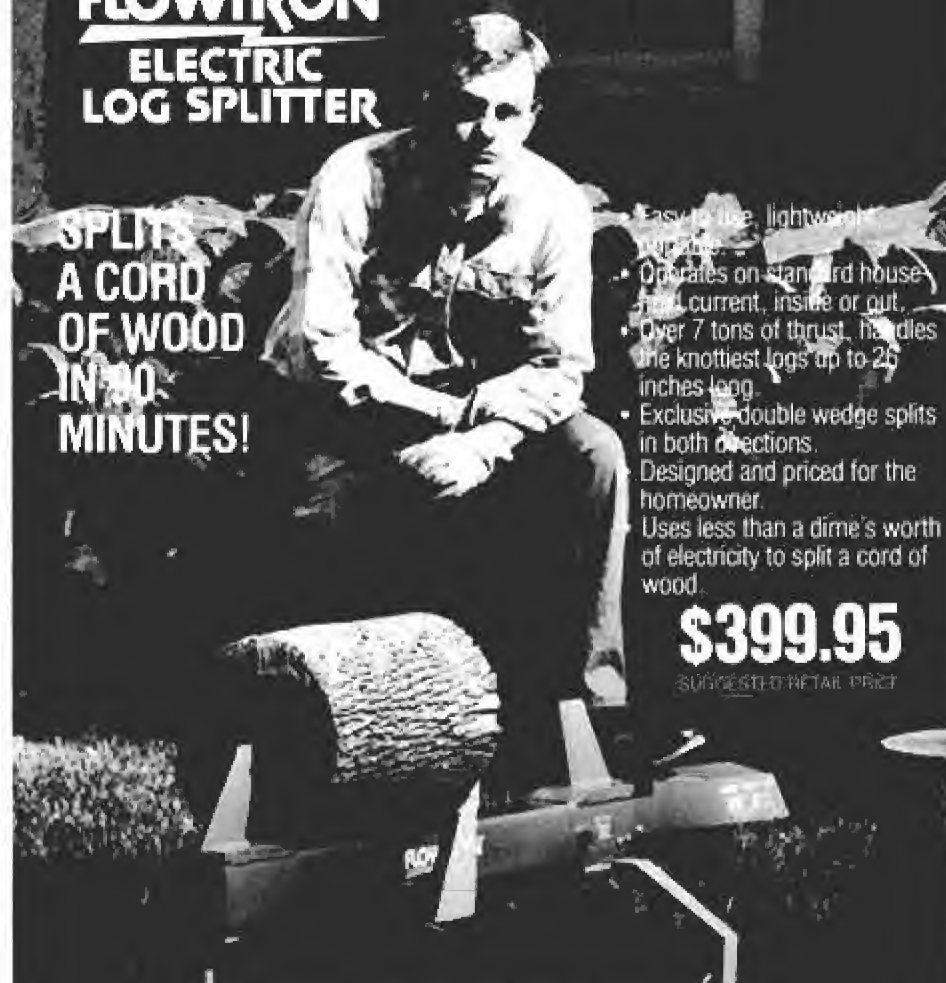
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448 How To Do The Split

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449 Don't Leave Your Heat Behind

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450 Need Home Fix-up?

You can do home repairs and remodeling jobs that last the easy way. Colorful brochure gives details on DAP products for a wide range of home fixup, energy-saving caulking and paint-up needs. From DAP Inc. Free

451 T-I-M-B-E-R

Pioneer Chainsaw has been cutting it for over 40 years. 4-color brochure offers a chainsaw for every need . . . for the homeowner, farmer or professional logger. Includes specifications and attachments for each model. Free

452 A Beautiful Barrel Stove?

The Sotz Corp. answers yes to that question and thinks you'll agree when you learn how its Heater Kit can keep you warm and save money. The 10-page "Sotz News" provides information on this barrel heater, heating water, drying wood, the Monster Maul log-splitter and more. Free

453 Fireside Cheer

You will enjoy the cozy glow of your fireplace even more if you know all the heat isn't going up in smoke. Suburban Manufacturing offers literature about its fireplace inserts designed for economical heating without spoiling the attractive, warm fireplace atmosphere. Free

454 Building The American Dream

If you've always wanted to build your own home, Lincoln Logs may have your answer. Brochure provides details about their Basic Log Home Package which includes materials and instructions. Free

455 Inside Story On Insulation

Here's an 8-page homeowner's guide to saving energy. Tells how and where to insulate for economy and comfort. Free from Owens-Corning Fiberglas.

456 Crowning Glory Of Your Home

A full-color, magazine-size brochure is filled with helpful tips on everything from the right color roof to energy savings. Sections on resale value, best roofing buys, styles available and more. From CertainTeed. Free

457 Water Shouldn't Dampen Your Home

A fold-out brochure from Thoro System Products shows you how to waterproof your home. Includes schematic drawings that pinpoint concrete and masonry trouble spots and a special section on how to correct damp basement walls. 10¢

458 Paint Your Wagon . . . And Anything Else

A new brochure from Rust-Oleum is designed to assist the do-it-yourself painter in selecting and applying protective coatings. Includes surface preparation and coating recommendations for both indoor and outdoor jobs and hard to paint objects. Free

459 All-Season Coats

Daly Protective Coatings would like you to know about their Asbestos-Free[®] coatings and cements. Brochure uses a question and answer format to discuss the use of non-asbestos roofing products for repairing cracks, waterproofing and to reflect heat and sunlight. \$1.00

460 Capture The Energy Of The Sun

Here's a catalog that describes how to reduce home heating costs by collecting solar energy in a beautiful sun space. Build a passive solar greenhouse from do-it-yourself kits. Includes tax credit guide. From Four Seasons Solar Products. \$1.00

461 Getting Down To Earth

THE EARTH SHELTER BOOKSTORE features a large, up to date selection of books on earth sheltered living. There are books for beginners and technical books for the do-it-yourselfer. Catalog plus special report, "27 Reasons Why You Should Consider Earth Sheltered Living" \$1.00 (refundable).

462 Reclaim Heating Costs

25-40% of your heat goes up the chimney. Illustrated brochure from JMC Energy shows how its Scotchman[®] Heat Reclaimer uses wasted heat to reduce fuel bills. Free

463 Split The Energy Crisis

Here's one answer to the energy crunch . . . build your own hydraulic log splitter. It exerts 10,000 pounds of pressure and splits easily 2-foot logs up to 14" thick. Complete plans from POPULAR MECHANICS Project Library. \$8.95

464 State Of The Arc

Arc Welding Projects is a 272-page book with plans, photos, drawings, instructions for making 114 different projects: tools, trailers, stoves, log splitters, boats, recreational equipment, etc. This book shows you how to make these at a fraction of the cost of buying. And all it costs is \$5.00.

465 Classic Heating With Coal

Coal and wood burning stoves are presented in designer settings in this full-color brochure. Featured are a complete line of imported "Classic Stoves", plus a booklet on the "Story of Coal". From Classic Stove Works. Free

466 Top Tools

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467 Be Loose-Stay Warm

You can pour yourself a cheaper fuel bill according to this brochure from Diamond Shamrock. Describes quick and easy steps for installing Dacotherm, a new loose fill insulation material. Free

468 Beauty And The Heat

32-page brochure illustrates how to combine the benefits of a fireplace heat extractor with the beauty of the hearth. The entire workings of the stainless-steel Amplifire, including thermally protected motor, are inside the fireplace. From Portland-Willamette. \$1.00

469 End Caulk Confusion

This informative booklet explains the difference between the various types of caulk available today. It tells where and when to use caulk, gives helpful preparation tips, and explains the techniques for properly applying caulk for a professional looking job. From Franklin Chemical Industries. Free

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Most of us simply don't understand just how wasteful and costly an ordinary tank-type hot water heater really is. But, if you will just think about it for a moment you will immediately realize that much of the energy used to heat your basement tank of water is dissipated right through the walls of the tank itself and into your storage or crawl space area.

The Perfect Answer-New Thermo Tankless Instant Hot Water Heaters!

The answer is simplicity itself—if losses are created by the need to keep large volumes of water standing in a tank, why not-eliminate the tank? And, that's just what the Thermo has done. We have eliminated the tank—and in its place we have developed a tiny, super powerful, instantaneous heating unit which ACTUALLY CREATES HOT WATER AS YOU USE IT. A microswitch on the unit automatically turns on the moment hot water is needed. Then a continuous stream of delightful, sparkling hot water flows from the tap for shower or wash basin. IMAGINE—as much hot water as you want—produced in a never-ending stream as long as you need it. And the Thermo unit is fully adjustable too—temperatures from cool to steaming hot can be obtained at the turn of a dial. Installation is simple—just a cold water inlet and electrical or gas power—THAT'S ALL!

The Ordinary Tank-Type Hot Water Heater Is The Most "Energy Costly" Appliance in Your Home.

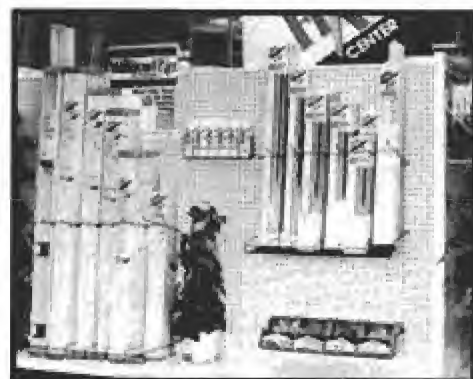
Did you know that an average tank-type heater will use as much as 4800 KWH of power in a year. Nothing in your home even compares to that for wastefulness and operating cost. By comparison, your refrigerator—usually opened several dozen times a day and placed in a hot kitchen, uses only 1/3 as much energy. In this day of rising costs and energy consciousness, a new THERMAR TANKLESS INSTANT HEATER should be considered for every home.

U.L. Approved Electric and AGA Approved Gas Models Thousands in Use Around The World

New models provide energy and cost efficient hot water for campers, boats or luxury homes. You'll recover the initial cost many times over in fuel savings as the years pass. And, you'll enjoy a lifetime of hot water—shower after shower after shower! Ordinarily, tank-type heaters can't make that promise—No matter how much they cost! The Thermo Instant Tankless Heater heats water AS YOU NEED IT—on demand. Just open the faucet and get a luxurious, never ending rush of steaming hot water.



- REPLACEMENT CHANNELS
- HORIZONTAL WEATHERSTRIP
- SPRAY LUBRICANT
- POWER LIFTERS
- TAKE-OUT CHANNELS



For Weather-Tight Windows that work like NEW!

The Window Fixer Center has just about everything you need to make your problem wood windows work like new. Five Window Fixer brand products have been specially designed and formulated to correct window problems.

Replacement Channels restore complete function and renew permanent effective weatherstripping.

Horizontal Weatherstrip seals leaky window areas at top, middle, bottom.

Spray Lubricant is specially formulated to clean and lubricate wood windows.

Power Lifters provide extra-lift for heavy, hard-to-reach and insulated sash.

Take-Out Channels allow easy sash removal for cleaning and painting.

Don't settle for 'make-do' solutions. Why buy products that aren't designed for double-hung wood windows and leave you with a window that never seems to work correctly when you can rely on Window Fixer brand products. The next time your windows give you a problem head for the Window Fixer Center at your nearest hardware store, home center or lumber yard. Window Fixer brand products assure you that you'll get weather tight windows that work like new.

Quaker City Mfg. Co.

SHARON HILL, PA 19079

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Melrose Square, Greenwich, CT 06830**

TH4

I would like to cut my hot water heating bills in half! Please RUSH your FREE catalog of THERMAR INSTANT, TANKLESS HEATERS. Include details of the absolutely unique 10-year guarantee and replacement plan. I understand that I am under no obligation to buy anything and no salesman will contact me.

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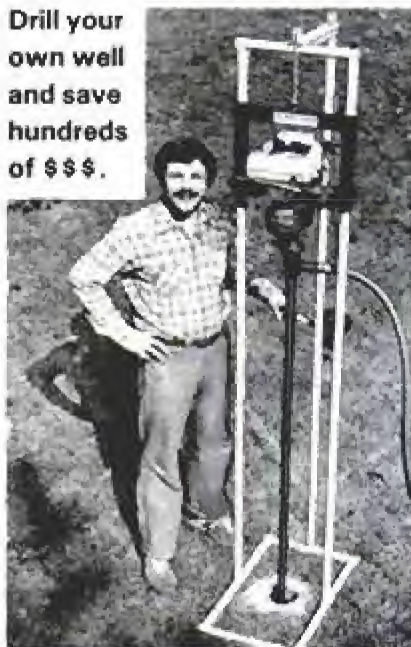
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HOME ENERGY GUIDE

In-wall heater is easy to install

It makes a great deal of sense to install an auxiliary heater in the bathroom. It allows you to heat that room without turning up the house thermostat whenever



In-wall quartz heater is rated at 1,200 watts.

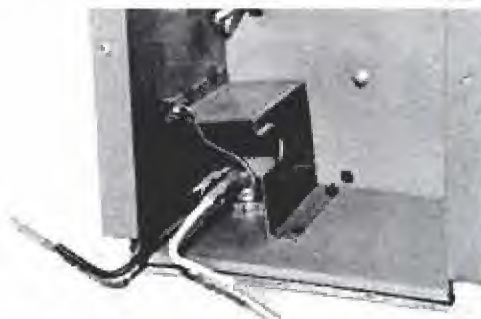
someone takes a shower or bath. For that reason, I recently installed the heater that's pictured on this page. This particular in-wall unit is extremely efficient and it can be installed quickly, because the manufacturer has come up with a well-engineered, snap-in bracket system.

Manufactured by Boekamp Inc., 8221 Arjons Drive, San Diego, Calif. 92126, the heater is also available in flush-mount wall and freestanding models. Sold at department stores and home centers, all three models are priced at \$59.95 each.—H.W.



Cutout dimensions for unit are on the instruction sheet. Mark outline on wall, bore corner entry holes and complete cutout with sabre saw (Inset).

Ears on box must be flattened, using a hammer, to get box into wall cutout.



Electrical wires enter box through a knockout and are secured to box with connectors. Housing installs in the wall with two brackets, each one fitted with two bolts and wingnuts.



Plastic pieces—packed around quartz tube—must be removed before you turn the unit on.

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INTERburner is here to
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But if you heat with oil, you *can* do a lot to cut fuel consumption—and still keep warm.

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Rugged aircraft-aluminum cone has grab-acting grooves to secure wedge.



Fresh-cut, 10-in.-dia. log was split with only six, one-hand, light-sledge blows.

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Splitting logs is hard work, whether you do it with an ax or with sledgehammer and wedge. Thus, when this aluminum log splitter was claimed to make the task easier, we decided to try it.

Called Woodpopper I, the wedge—actually a cone—achieves a high degree of efficiency because of its shape and weight. Unlike conventional wedges that simply absorb a great deal of the sledge impact, the lightweight (20-oz.) Woodpopper is said to transfer the impact force downward into splitting action on the log.

I did a comparison test while splitting logs from a recently felled oak. First, I used a conventional 4-lb. wedge. On the average, it took 14 blows with a 6-lb. sledge. But I needed only six blows when using the cone wedge. My test wasn't scientific, but the tool did save me work.

The cone wedge is constructed of tough, aircraft-type landing-gear aluminum for durability. Specially designed grooves in the nose grab the wood when the split begins to keep the wedge from popping out.

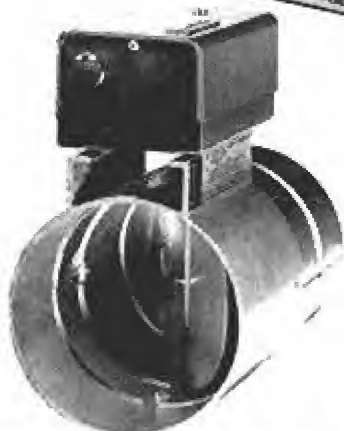
Woodpopper I is \$16.95 postpaid. Giesler Engineering, Box 80, Lenni, Pa. 19052.—Rosario Capotosto

New energy products you should know about



The OptiMiser saves energy by resetting home temperatures four times daily: at get-up, leave-home, return-home and go-to-bed times. Central heating-cooling model lists for \$219; heating-only, \$239; qualifies for 15-percent income-tax credit; NuTone, Scovill, Madison and Red Bank Rds., Cincinnati, Ohio 45227.

The Furnace Brain controls the gas valve to heat a house in increments, instead of by a blast of output that overshoots the thermostat. Said to cut heating bills, unit is \$60 postpaid from Settler Corp., 881 South Main St., Centerville, Ohio 45459.



The automatic vent damper for gas-fired furnaces and boilers are controlled by a room thermostat. Damper closes when furnace is off, keeping heated air from escaping, and opens when furnace is on. The D80B vent damper is from Honeywell, 10400 Yellow Circle Dr., Minnetonka, Minn. 55343.

(Please turn to page 147)

Seal Your Home with Touch'n Foam

Save On Fuel Bills All Year Round!

Drafts and air leaks are robbing your home of energy dollars! Touch 'n Foam is the easiest, most economical way to seal them off. The adhesive foam expands to

fill hard-to-reach openings and provide air-tight insulation. One can yields up to 3 gallons of cured foam—more sealing power than 30 tubes of caulk! Stop costly energy leaks... Seal your home with Touch 'n Foam! Use Touch 'n Foam all around the house...

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A great bench model drill press with 3/4" chuck and Morse Taper. Ideal for the home handyman.

Here's a heavy-duty 14" drill press at a money saving, low liquidation price! The cost is even less than some of those little "sissy" models you see around town.

This 160 lb. "brute" has the power and the "guts" you need to drill through steel, cast iron, aluminum, brass, wood, plastic. Head and base are made of strong, fine-grained cast iron. Heavy walled machined column increases rigidity, cuts down vibration for smoother operation. Includes 3/4 hp. motor with standard NEMA 56 frame.

Oil table swings 360° and tilts 0° to 45°. Precise up and down movement of table with rack and pinion. Recessed socket in head lets you put in an electric light bulb for bright illumination of work. We priced these way down low to sell them FAST! Don't delay. Order yours right away.

- Capacitor start 110V motor; grounded receptacle; 10 amps.
- All belt pulleys on ball bearings. 5" largest pulley on spindle (high torque).
- Quick release belt tension.
- Chuck is 3/4" No. 3 J.T. Arbor
- 11" x 17" base; 2 3/4" column diameter.
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- Spindle to table (max): 15 1/4".
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Please ship 12-speed Drill Press(es) at \$198.00 each. I will pay the shipping charge to driver upon delivery. (Allow 4-5 weeks for delivery. Add an extra 2-3 weeks if paid by check. Sorry, no C.O.D. orders.)

☐ Also send Vise Attachment at \$25.00. (In separate carton. NO shipping charge.)

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Charge my: ☐ Mastercard ☐ VISA ☐ American Express ☐ Diners Club

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Fully enclosed belt guard case for safety!

Precision ground quill has milled rear rack



Recommended bit sizes to use:
In cast iron, 1/2". In steel, 3/8"
In wood, 1/2" or even more with Morse Taper bits.

HEAVY DUTY 5/8" CHUCK

Table rotates 360° tilts 0° to 45°. Indicator scale both sides!

A big, 160 lb. heavy-weight!

Quick release for belt speed changes.

CAPACITOR START, 110V, 3/4 h.p. MOTOR!

Recessed light for bright illumination of work!

Adjustable stops.

MORSE TAPER



VARIABLE 12 SPEEDS!

Change speeds easily with the V-belt drive. Select from 12 different speeds: 280-3650 rpm. Uses standard size V-belts.

Rack and pinion for fast, precise vertical adjustment of table!

Heavy walled machined column cuts down vibration!

Sturdy 2-7/8" diam. column is bolted to base, NOT pressed on!

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For maximum clamping, holding power. Steel jaw faces; 4" jaw width, 1 1/4" jaw depth, 3 1/4" jaw opening. Cold rolled steel screw.



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Rural Route Customers: If truck carriers do not normally deliver to your home, include a note with this order, stating nearest town address of a store, friend, truck terminal where we can ship this.

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(Continued from page 145)



This electronic fuel gauge for wood stoves or furnaces beeps an alarm when the fire needs tending, so you don't have to open the firebox door to check. It consists of a pipe-mounted sensor (shown), connecting wire and control box. Battery-powered unit is \$45 from Stove Sentry Inc., Box 485, Greenville, N.H. 03048.

Fireplace and Stove Repair is a black silicate patching compound designed to seal leaks and point up joints between firebricks in your wood stove or fireplace. It hardens with heat, is asbestos-free. The 11-oz. tube fits standard caulking guns. It's \$2.19 in hardware stores and home centers, from Red Devil, 2400 Vauxhall Rd., Union, N.J. 07083.



The Solar Micro window-mounted solar heater weighs 25 lbs. and measures 3 x 4 ft. A 60-c.f.m. fan circulates house air under a black, tetrahedron-embossed, styrene surface. Top output is 2,000 B.T.U./hr.; cost is \$400. Buyers may qualify for a 40-percent Federal Energy Tax Credit. For the nearest dealer, write Solar Micro Inc., 11 East Carmans Rd., Farmingdale, N.Y. 11735.

(Please turn to page 149)

THE RIGHT CAULK FOR MOST ANY JOB.



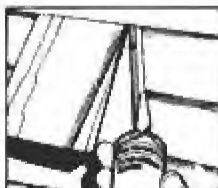
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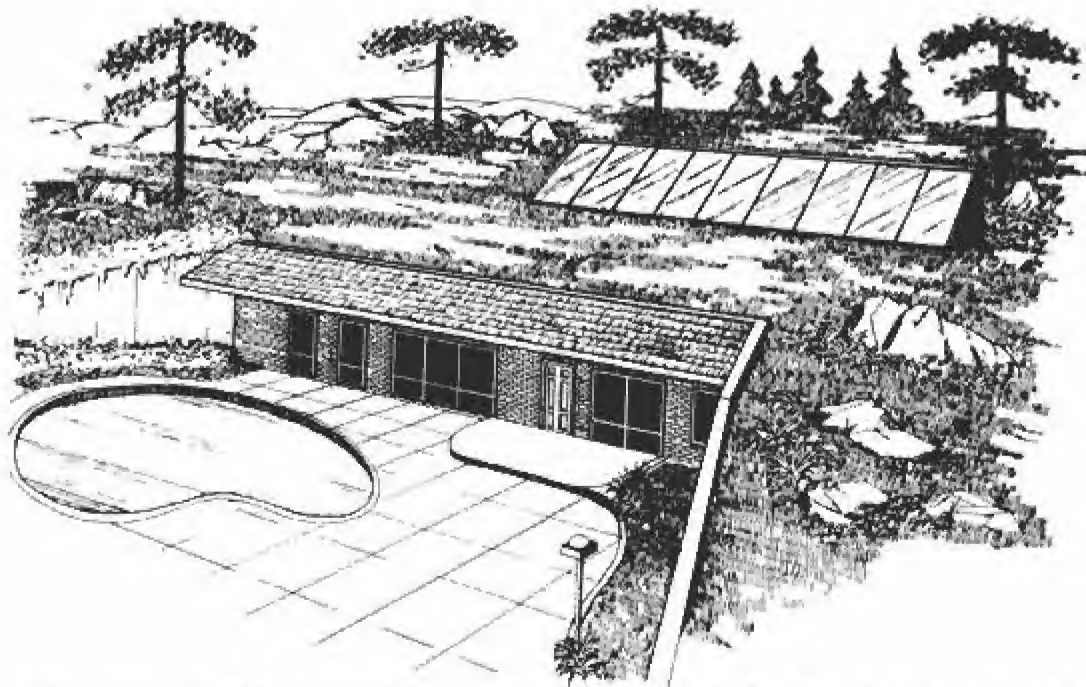
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The Primer To Earth Sheltered Living — 24 page booklet gives basic information on underground homes — advantages, site selection, planning, financing, building tips, construction and landscaping. Also includes a reference section listing sources for other books and articles on earth sheltered housing. **\$3.50 ppd.**



Plans For The Future — 44 page book features full color artist's renditions of 26 different underground home designs showing the variety in style and appearance that's now possible in these energy efficient homes. Also includes floor plans, sketches and descriptions of the different types of earth sheltered homes (hillside, earth bermed, totally below grade level) and

a discussion of the most desirable sites and climates for building each type. Structural blueprints for these homes are currently in use in 43 states. Details on the blueprints and forms for ordering them come with each book. **\$7.95 ppd.**



Underground Homes Information Manual — An information system unique to the field of earth sheltered housing. It's a large 3-ring loose leaf binder which serves as a central source of information on all phases of earth sheltered housing. The indexed sections contain detailed information on site selection, construction methods, structural

designs, excavations, footings, landscaping and financing — plus seven complete books. Water Proofing, Heating/Ventilation/Air Conditioning, Insulation, Construction Cost Estimation Guide Book, Building Tips, Structural Considerations and a Resource Guide Book listing 218 different sources (books, magazines, articles, builders/contractors, architects and associations) of additional information on earth sheltered living. Also includes literature from leading manufacturers and suppliers on the newest products available for the earth sheltered home. This is a complete information system on earth sheltered living. **\$29.95 plus \$2.00 shipping/handling.**

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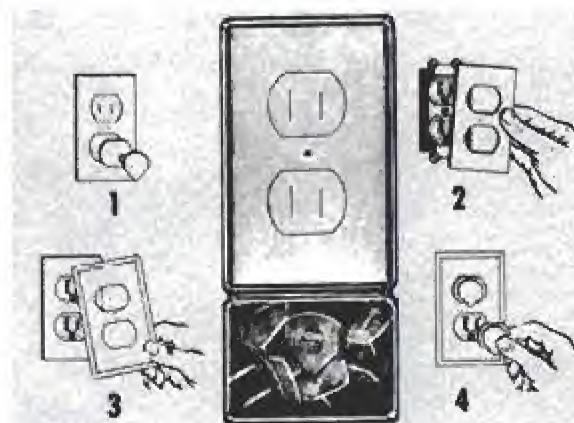
HOME ENERGY GUIDE

(Continued from page 147)



A lot of heat escapes through windows. The manufacturer of Window Quilts claims you can cut that loss dramatically with these easily installed thermal shades. At home center stores, Window Quilts are about \$60 for an average-size 2½ x 4-ft. window. If not available, write Appropriate Technology Corp., Box 975, Brattleboro, Vt. 05301.

Decotherm silicate insulation has a high heat transfer resistance, according to the maker. Packaged in 6-lb. bags of "BB-sized" granules, it pours into all openings. Available in home center stores, a bag of insulation is about \$5.50. Decotherm is made by Diamond Shamrock Corp., 351 Phelps Court, Box 2300, Irving, Tex. 75061.



A lot of air goes through switches and outlets. Wind-jammer Insulators are designed to stop this airflow. Packages contain insulators for both outlets (drawings 2 and 3) and switches. Also included are safety caps which are inserted in two- and three-prong outlets (drawings 1 and 4). About \$1.69 a packet, the UL-listed insulators are made by Cable Electric Products Inc., Box 6767, Providence, R.I. 02940.

(Please turn to page 150)

**We engineered it
So you can build it...
And we made building it FUN!**



You can build this genuine replica of the 1952 MG-TD. We've designed this easy to assemble kit to make building it as much fun as driving it. After a few enjoyable weekends building the MiGi, you will be on the road in your own classic sports car.

Call 1-800-328-5671, toll free, for a

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PM-3

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Stove #2: The Large Federal Box Heater. Classic styling. Burns wood and coal. Features include ceramic glass window, firescreen for open hearth burning, ashbin and drawer, baffle, top and back flue outlets, externally operated shaker. Airtight. All cast iron construction. Holds logs to 18", 35 lbs. coal. An outstanding value. \$359.95.



Stove #6: The Large Federal Convection Heater. Combines federal styling with modern technology. Internal chambers create continuous flow of warm air. Burns wood and coal. Two ceramic glass windows, firescreen, ashbin and ashdrawer, front and side loading doors, externally operated shaker, baffle, top and back flue outlets, solid brass trim. Optional blower. Airtight. All cast iron construction. Logs to 22", 35 lbs. coal. An exceptional stove. \$559.95.

Cast Iron Kettle: 17 pounds of durable cast iron. Holds 6 quarts. Excellent stove humidifier. 30 day money back guarantee. To order send check or call with Visa or MasterCard number. \$34.95.

All prices include freight prepaid, delivered to your door anywhere in continental U.S.



For free catalogue and stove package describing all 11 of our stoves and fireplace inserts, write or call (toll free). Add \$1 if you want it rushed by first class mail.



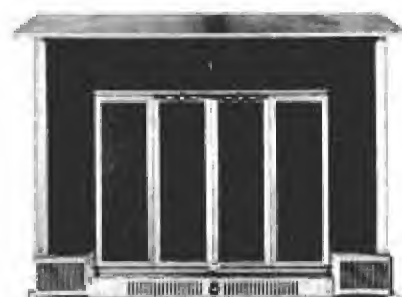
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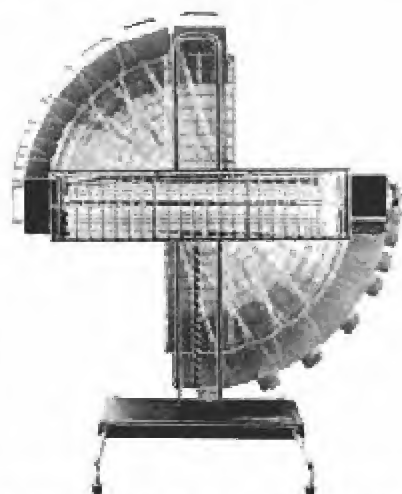
(Continued from page 149)



Woodmaster heater, available for wood or for coal, is claimed to cut fuel costs up to 60 percent. Both the Woodmaster (from \$350) and the Coalmaster (from \$400) fit into an existing fireplace or may be used free-standing. They're made by Suburban Manufacturing Co., North Broadway St., Dayton, Tenn. 37321.



Heat exchanger, designed to increase fireplace efficiency, can be installed in minutes in most fireplaces, according to the maker. Comfort Crest Model 28120 (\$595) has a black finish with brushed-brass trim. Yard-Man Co., Box 36900, Cleveland, Ohio 44136, is the manufacturer.



Quartzpower pivots to vertical, horizontal or any angle between, and raises or lowers from 32 to 42 in. off the ground in horizontal position to provide a wide field of heat. It contains two 750-watt quartz heating elements and dual power switch. Model TX-1 is \$65 postpaid, from Quartzpower Inc., 17 Barstow Rd., Great Neck, N.Y. 11021.

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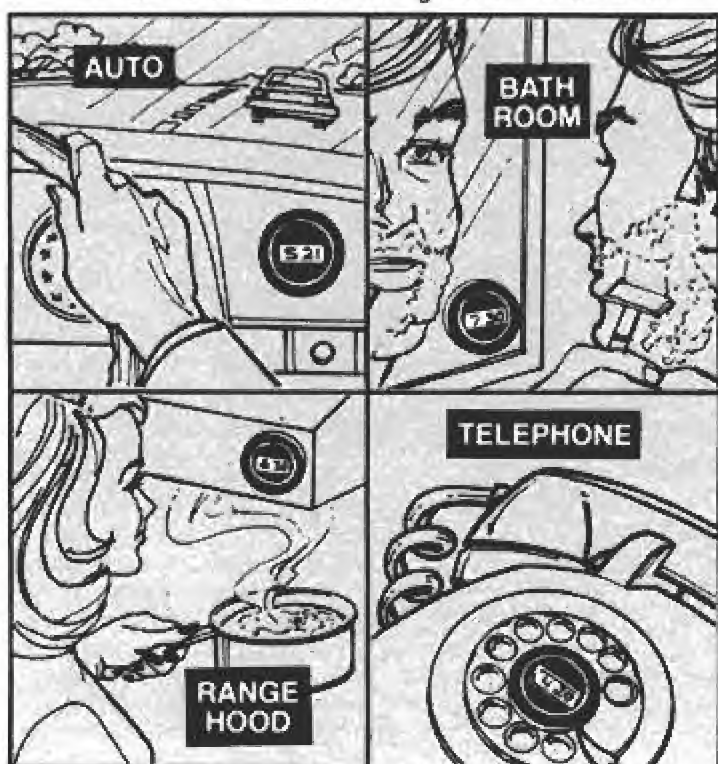
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BUILD PM'S NEW DIVING SCOOTER

(Continued from page 79)

pleasantly surprised to find that the single motor would provide virtually the same performance as the earlier design having two motors. One reason for this is that the motor is a hefty 24-volt model—more powerful than the 12-volt types originally used.

The motor is also fully enclosed within the hull, with nothing protruding outside. In the earlier design, the two motors were mounted in outrigger pods flanking the hull, and the pods themselves produced speed-killing drag that the single-motor design eliminates. The result is increased efficiency, with the added benefits of less weight, lower cost and more simplified construction.

Special Intake scoop

The motor is mounted in the stern, its small plastic propeller safely shrouded by a slotted skirt. A special high-efficiency intake scoop, called a kort nozzle, forces water in through the slots, improving the flow around the prop and increasing its thrust. Two small 12-volt motorcycle batteries fit neatly in the narrow hull and are wired in series to run the motor. A headlight in the nose provides underwater illumination and adds a sporty touch.

Like our earlier version, the new Scuba-Tow SEL was designed for PM by Kent Markham, a marine construction expert and teacher at Nathan Bedford Forrest High School in Jacksonville, Fla. The plans include large-scale drawings, full-size cutting patterns and an illustrated instruction manual.

Buying the parts

By special arrangement with the motor manufacturer, PM readers will be able to purchase by mail just the motor's power head, less tiller shaft and other hardware, thus saving money. For your convenience, the aluminum hull pipe can also be obtained by mail in the exact length required. The batteries are made for Harley-Davidson motorcycles and are readily available through Sears or at local motorcycle shops.

One caution: In experienced hands, the Scuba-Tow SEL can reach depths of more than 100 feet and remain safely watertight. It should be used with extreme care, however, as it will propel you considerably faster and farther than your regular swimming rate with flippers alone. Only qualified scuba divers should attempt deep dives, and no diver should go deeper than he usually would without the scooter. **PM**

PRESSURE-CHAMBER VOLUNTEERS OPEN UP DEEP-SEA SPACE

(Continued from page 82)

oratory, exhibited an alarming array of debilitating symptoms. They showed brain-wave irregularities associated with pathological states, tremors and shaking. And they were nauseated and tired. Dr. Bennett, who was supervising the dives, first suspected that helium was the cause. Later, problems were traced to pressure. Bennett termed the collection of symptoms the "high-pressure nervous syndrome" (HPNS).

HPNS was studied in many subsequent dives. It was extremely pronounced in a 1979, 38-day heliox simulated dive to 1,800 feet at the U.S. Navy's high-pressure complex at Panama City, Fla. Though the divers were young and healthy, and had trained hard, they suffered marked HPNS symptoms: nausea, vomiting, gas pains, diarrhea, fatigue, joint pains, dizziness, tremors, disturbed sleep, nightmares and impaired thinking ability. At 1,400 feet, they showed signs of dyspnea (air hunger), a condition that became worse the deeper they dived. Exercise caused severe dyspnea, which has been likened to trying to breathe through a straw.

Dr. Bennett and other researchers recognized early on that the physiology involved in HPNS is complex. Simply stated, they believed that the tremendous pressures encountered in deep dives compress cell membranes of the brain, affecting the "sea" of solutions inside and outside nerve cells. A disturbance in these chemical solutions prevents nerves from firing normally.

A touch of nitrogen

But studies with animals and human subjects indicated that there was a way to combat HPNS: by bringing nitrogen back into the picture. The gas that was a danger in compressed air at 200 feet appeared to be beneficial at greater depths.

In 1974, after Dr. Bennett had come to Duke, the theory was borne out in a series of Trimix (helium, oxygen and precisely monitored amounts of nitrogen) dives to 1,000 feet. The addition of nitrogen to the gases permitted a rapid rate of compression without HPNS.

The installation of a 3,600-foot chamber in 1977 led to a series of dives which explored the delicate balance of breathing gases required at greater depths and different rates of compression. Not surprisingly, two of the sponsors of the simulations—named the Atlantis dives—were Shell International and Oceaneering International, a

Houston-based diving company that operates in many parts of the world. Speedy compressions are essential in oilfield diving. Every additional hour needed to compress divers raises already-high costs. It requires more than \$50,000 a day to operate a huge drilling rig. Downtime while waiting for divers to make underwater repairs makes oilmen nervous.

Atlantis I and II took Trimix-breathing divers to high-pressure conditions at breathtaking speed. But in both simulations, the men experienced some signs of HPNS.

The Atlantis III mission

Atlantis III was scheduled for early in 1981. The divers went into training on Dec. 1, 1980, riding endless miles on a bicycle ergometer to establish their individual optimum work levels.

During the training period, PM visited the campus to interview the three young men and Bud Shelton, 40, a participant in the first two Atlantis dives and a veteran of diving research at Duke.

Steve Porter, a 25-year-old professional diver who participated in Atlantis II was chosen as the lead diver for Atlantis III. The tall, broad-shouldered Porter spent six years with Oceaneering International, working off the coasts of Spain and Brazil and in the North Sea. On one saturation job in the North Sea, he went down to 534 feet, his deepest descent in the open sea. "Divers are exact about that kind of thing," he told PM with a smile, "because they're paid by the foot."

Len Whitlock has been a commercial diver since 1973 and has worked in the Gulf of Mexico, off South America and in the South Pacific. Like Porter, he is a graduate of Oceaneering's Commercial Diving Center in California. Whitlock is 29, compact and bearded. At 24, Eric Kramer is the youngest member of the group. He is a former Navy Underwater Demolition Team diver with no previous deep-diving experience.

We asked the group what dyspnea was like. "It can really hammer you," Bud Shelton said, recalling his experience during Atlantis II. "It first happened at 1,500 feet when I was working on the [stationary exercise] bike. It wasn't just tough breathing—we're all used to that. But suddenly, you become aware that you're not getting enough of something. You try to relax, try to

(Please turn to page 154)

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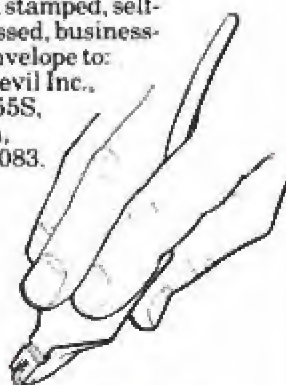
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WE'RE SOLD ON QUALITY.

PRESSURE-CHAMBER VOLUNTEERS OPEN UP DEEP-SEA SPACE

(Continued from page 153)

get it out of your mind, but it doesn't go away." The feeling, the divers said, generally does go away with a few minutes' rest.

"Then at 2,000 feet, there was a marked dyspnea," Shelton continued, "even with absolutely no activity. It became a progressive problem as we reached maximum depth. I was not incapacitated, but anything that would interrupt breathing became a major problem."

"I couldn't talk, couldn't eat, couldn't even chew gum. To eat, you've got to close your mouth and that makes you short of breath. Even getting into bed at night was a real job. But the unusual aspect was that it wasn't made worse by regular physical activity. It's a strange kind of thing."

The trauma of a sneeze

Sneezing, not an unpleasurable experience at sea level, is traumatic at depth. "It feels," said Porter, "like you're blowing off the top of your head—and your right arm, too."

The unusual environment has another strange effect. "You dream all kinds of bizarre things, things that don't add up," Shelton said. "You float in space. Or you get a sense of depression and anxiety."

Laughing, Porter said: "You dream everything, from the wonderfully exciting and erotic to the really terrifying."

"Normally, I never dream," said Whitlock, "but down there, I wake up with a storybook full of stuff."

On Jan. 23, 1981, the three divers entered a spherical, 8-foot-diameter chamber in a corner of the lab. The "golf ball," as the people at Duke call it, would be their home for the next 34 days, the major portion of the dive. Here, they would follow a tight schedule within the confines of the white-walled steel sphere, their view of the outside world narrowed to the little they could see through tiny ports.

During the day, most of the floor space was occupied by a small table, used for eating and taking tests and as a solid base for withdrawing blood samples from each other's arms. At night, the table was put away to provide space for the fold-down bunks.

Through a floor hatch, the golf ball connects with a "wet pot" below, where divers can carry out tasks while in water. But in this experiment, the pot remained dry. It contained two essential items—a bicycle ergometer and a toilet.

Physical tests were run on the bike, the diver pedaling while wired

to an electrocardiograph machine and breathing through a Y-shaped mouthpiece that supplied breathing gases and collected exhaled breath.

Much of the time, the men wore headphones and microphones to communicate with each other and those outside. The divers' speech, distorted by the helium into a Donald Duck gabble, was made intelligible by the use of an electronic unsrambler.

The divers were taken down to the equivalent of 2,132 feet in seven days, twice as slow a rate of compression as that of Atlantis II. After four days at this plateau, when lung-function and other tests had shown that the divers were in excellent condition, pressure was increased beyond previous records.

A dial outside the chamber recorded the change in meters below sea level. The needle edged up slowly, passing 685, marking the equivalent of pressure 2,247 feet deep. Expectant support personnel passed three shot glasses of champagne through an air lock. When the needle hit 686 meters—the targeted depth—divers drank the flat champagne (its fizz overwhelmed by the pressure), thanked the people outside, and asked, in vain, for more champagne.

The return trip

Then the long decompression began. After 34 days, with the divers at about a 1,000-foot depth, they were transferred to an interconnected chamber. Their new lodgings were of relatively grand proportions—18 feet in length and 10.5 in diameter ("It felt like a football field by comparison," Steve Porter told us). The decompression, the divers said later, was the toughest part of the dive, because of the lack of physical activity and the boredom. They ate, slept, read and played with yo-yos. "But you can only play with a yo-yo for so long," Porter said. When the hatch finally swung open last March, all three had survived with no evident psychological scars.

Of course, they had done much more than survive. They had broken several records by staying 11 days deeper than 2,000 feet, seven days deeper than 2,132 feet and one day at 2,250 feet. They had shown that even at such depths, divers can avoid dyspnea: They can work hard and effectively. Like the shuttle astronauts, the three had proven again that limits on human exploration are elastic and that all of us still live in the age of the frontier. **PM**

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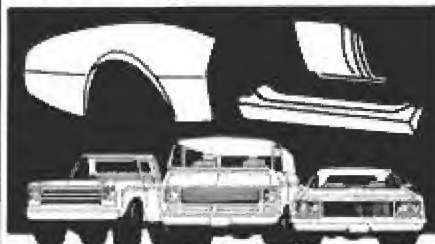
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NEW FOR BETTER BIKING

(Continued from page 87)

tach the fore and aft frame pads and you're off.

Rideable's 20-inch tandem weighs less than 50 pounds and stores neatly in car trunks, boats, aircraft, RVs, closets and other small compartments. The bike can be purchased with seat posts of different heights for adults or children. Both sets of pedals freewheel independently, so if one rider wants to rest, he can. The tandem, which retails for about \$375, comes in red, blue or white, and includes a tool bag. It'll be available soon. For more information write to Rideable Bicycle Replicas Inc., 2433-47 Telegraph Ave., Oakland, Calif. 94612.

High time for high wheels

Rideable is the only company in this country that builds old-fashioned high wheelers on a regular production basis. The firm currently offers two different-sized reproductions of 19th-century British high wheelers. These bikes were called penny-farthings because, at the time, the penny was a large coin and the farthing a small one—like the wheels of the bicycles. In Rideable's case, the front or "ordinary" wheels are 38 or 48 inches in diameter and the rear ones are 16 inches.

High wheelers were all the rage before 1874, when "safety" bicycles came into vogue. And it's true that high wheelers were neither terribly safe nor practical. But Mel Barron modified the design slightly by setting the seat lower on the frame for easier mounting and pedaling. The front fork is also a bit wider, as is the front axle, for better riding stability.

Some penny-farthings go to hobbyists and collectors. Since genuine high wheelers sell for \$1,000 to \$5,000, a collector might buy a \$600 copy for enjoyment.

The 38-inch Rideable high wheeler lists for \$599 in standard black; the 48-inch is about \$25 more. Replica high wheelers are sometimes ordered in chrome or nickel plate, which adds several hundred dollars to the price. And RBR has sold at least two gold-plated models for an additional \$5,000 each.

Rideable also custom-builds three- and four-wheel "bicycles" patterned after 19th-century designs—so-called "Socials." These are for the less daring.

How hard are the high wheelers to ride? Not hard at all, if you have a good teacher, like RBR's Diana Hoffman. My son, aged 16 and an experienced 10-speed rider, mastered the basics of high wheeling in about 30 seconds.

My own learning time came down to about the same. And I must confess: The thrill of sitting so high in the air, combined with the dawning realization that somehow you're going to have to get back down again—well, there's no feeling quite like it.—Mike Lamm

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What difference does it make? Well, air resistance increases in proportion to the square of the speed. This means that a .50-Cd sedan requires 5 hp to hit 30 mph, but 20 hp to hit 60 mph; a .30-Cd sedan requires just 3 hp to hit 30 mph and less than 10 hp to maintain 60 mph.

At the same time, aerodynamic drag typically accounts for 70 percent of total vehicle drag—10 percent of the available power goes to overcome tire and mechanical resistance, 5 percent for air drag through the radiator and internal passages and 15 percent to relatively unavoidable “skin friction.” The lesson is clear. Cars with a low coefficient of drag require substantially less power—and consequently, less fuel—to achieve the same performances as high-drag designs.

The problem is how to take the “three-box” design of a passenger car—engine, passengers and luggage—and minimize drag, while still leaving useful room. The ideal teardrop shape, for example, has a long tail that’s a cone with a 15° point. Imagine a car-sized ice-cream cone fastened to the back of a Cadillac and you’ll have some idea of the magnitude of the problem. Interestingly, half-way solutions like a fastback roof or sloping rear window create terrible turbulence. Aerodynamics is an either/or science: The airflow is either parallel to the surface or whirling off in drag-creating eddies. There is no compromise solution.

When a viscous substance flows around an object—and all fluids have some viscosity—skin friction always creates a thin layer of comparatively still fluid next to the surface. This is called the “boundary layer.” As long as the boundary layer remains attached to the surface, you will have smooth “laminar flow.” If the stream flowing past the object loses pressure, the boundary

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SEARCHING FOR THE PERFECT .10

(Continued from page 77)

engineering even a power train, let alone a new engine.

Air is surprisingly viscous. Like any fluid, it flows in a given direction, and is deflected by objects in its path. In the science of fluid dynamics, a “streamline” is defined as a hypothetical “line” drawn tangent to the direction of flow of the “stream.” When that flow is not perfectly streamlined around an object, the fluid begins to whirl and eddy, instead of moving linearly, creating turbulence. This turbulence, in turn, creates “form drag.” An object which is truly streamlined, then, is simply shaped so that its surfaces conform to the natural direction of the flow, eliminating form drag.

The teardrop shape

Theoretically, a falling teardrop has a perfectly streamlined shape, so back in the early days of aviation, it was assigned a coefficient of drag of 0.0. At the opposite end of the scale, a flat square panel—say, of plywood—was assigned the highest coefficient of drag, 1.0. More accurate testing later determined that perfect airflow is impossible to achieve, so the teardrop actually has a Cd of about .05. By the same token, a flat, square panel has even more drag than expected, somewhere around 1.15, depending on whose wind tunnel you use.

It is possible to build a car, complete with protruding tires and functioning air intakes, which approaches the teardrop in shape and has a Cd of around .10. But it is practical only at the Bonneville Salt Flats, where a car doesn’t have to parallel park or go up a driveway. Most standard sedans are in the 0.50-Cd range, and the best of current designs rate about 0.30.

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(Continued from page 157)

layer will thicken and develop "turbulent flow." This turbulence is usually the last step before the boundary layer detaches from the surface. The space between the quickly flowing stream and the surface will now be "stalled."

Stalled air tumbles and eddies away from the surface in a series of drag-creating whirlpools spun by the moving stream.

A moving object pushes a cone of high-pressure air in front of it. This high-pressure air flows up and over the hood of a car, and because of its pressure is relatively easy to keep attached to the surface. But the general profile of a car is like an airplane wing. The air flowing over the car must take a longer route than the air under the car. This means that somewhere over the windshield, the air loses pressure, and then must flow from a relatively low-pressure area to a high-pressure area before reuniting with air coming from under the car.

Even on the perfect teardrop shape, the boundary layer begins to thicken once the airflow passes this low-pressure shoulder, but under ideal conditions, never thickens enough to allow turbulence and boundary-layer separation. On the less-than-ideal shape of a car, however, tremendous drag is created when the boundary layer departs from the surface of the roof.

The Kamm tail

Over 40 years ago, Prof. Wunibald Kamm of Stuttgart, Germany, published *Das Kraftfahrzeug*, which tells exactly how to solve this problem. Kamm's ideas were first ignored and then misunderstood, with the result that he is just now being credited by modern-day aerodynamicists. In 1938, Kamm had already built a four-door sedan on the big, 3.5-liter, 117-in.-wheelbase BMW 335 chassis which had a Cd of only 0.23... lower than any functional passenger car built since.

Kamm did two brilliant things. He positioned the radiator air intake at the very nose, in the area of highest pressure, then ducted the cooling air out again at the base of the windshield. Just at the point where the airflow was starting to slow down and enter a low-pressure area, Kamm's design ejected a shot of relatively high-pressure air. This helped preserve the boundary layer up and over the roof.

But even this wasn't enough to preserve boundary layer adhesion all the way to the tail, even though Kamm gave the roofline the ideal

taper of a teardrop. So Kamm did something else. At the point where the boundary layer was going to separate from the roof surface anyway, he cut the tail off as bluntly and vertically as possible. This created a whirlpool of turbulent air behind the car, as one might expect. But this vortex of turbulence actually approximated the shape of a long cone with a 15° point, and the laminar flow conveniently stayed outside this stalled cone. In other words, Kamm used the turbulent air itself as a substitute for the impossibly long, conical tail of the teardrop.

The 'banana car'

Kamm's only true successor is Prof. Alberto Morelli from Torino. Morelli has worked with Pininfarina for two decades, and is the one responsible for the 1977 "banana car" sponsored by the Italian government's Consiglio Nazionale delle Ricerche. The CNR car is a four-door sedan built on a Fiat 131 Brava chassis, with a Cd of just .20.

The CNR car is a refinement of Kamm's 1938 BMW; the radiator cooling air is now directed through a series of venturis to bring it up to roughly the same pressure as the outside stream before it exhausts from four vents in the cowl area. Other air ejectors in the rear-window area and a small spoiler help shape the vortex behind the tail.

The CNR car goes beyond Kamm's 40-year-old design in the neat fairings around the wheels and "banana" profile. The concept of the constant-section banana shape is to make the top and bottom of the body as nearly parallel as possible. This reduces the low-pressure area over the roof, aids laminar flow and minimizes aerodynamic lift.

One of the problems with most low-drag body shapes is that the center of resistance is forward of the center of gravity. The effect is that of trying to shoot an arrow feathers first: extreme instability and a tendency to spin. The solution is a stabilizing fin or bodywork at the rear, to move the center of resistance back behind the center of gravity. Morelli's CNR car has a surprisingly high rear body line, with what aerodynamicists call "reflex camber" from low nose to high tail. Because of this, the CNR car is claimed to be more stable than any other low-drag passenger car design.

Because the profile of a car is essentially that of an airfoil, with faster, low-pressure airflow over the top, most cars develop aerodynamic lift. Typically, this measures only a

few hundred pounds at highway speeds, just enough to make the steering feel light. Racing-car designers have become the leaders in reducing lift, for the practical reason that at high speeds, all too many race cars want to take off and fly. Indeed, there's no longer a racing car in the world that doesn't develop negative lift—today's cars are literally sucked down to the pavement.

Morelli's CNR car develops positive lift over the roof, but negative lift at both front and rear. The two forces cancel each other out, so the CNR sedan is a "zero-lift" design. That's not extreme enough for racing, where you want a total negative lift condition—and preferably one that can be balanced from front to rear in order to "tune" the racer's handling.

Spoilers and wings

Racing aerodynamics has its own list of innovators. The first one to put the now-familiar "spoiler" across the back of his car was Richie Ginther, on a Ferrari at LeMans in 1961. The spoiler creates negative lift, helps shape the rear vortex and aids laminar flow. By the mid-'60s, Jim Hall of Chaparral had mounted inverted airfoils—literally, upside-down wings—at both front and rear. These could be adjusted to "fly" the car into the ground for maximum cornering force.

Formula One cars soon sprouted biplane and triplane wings mounted high above the "dirty" air around the body, where undisturbed "clean" air could act on them most effectively. The best of these wings were connected directly to the suspension members rather than the bodywork, could be adjusted for less drag on the straights and more downforce on the corners and literally pressed the tires to the ground. They were banned in 1968, after all too many cars lost control because of flimsily constructed broken wings.

What's currently considered the

optimum shape for a racing-car body was realized in the early '70s by Porsche on the 917-30 Can-Am car for Mark Donohue. In this design, the body sides are flat and perfectly vertical. The "air-dam" nose scoops close to the ground to eliminate as much airflow under the body as possible. Air intakes at the very front of the nose take in high-pressure air, which is then channeled along an upside-down airfoil within the nose and ejected out louvers in the fender tops at the beginning of a low-pressure area. At the extreme rear, there's a huge, adjustable airfoil to provide negative lift, with large fins to move the center of pressure behind the center of gravity, even in this tail-heavy, mid-engined car.

A 10-year-old 917 might still look up-to-date, but it's what you can't see that makes the 1981 models appropriately space-age, and Donohue's old Porsche something from von Richthofen's Flying Circus. The latest Can-Am cars are the most aerodynamically advanced racers in the world. The improbable leader of this revolution is a Long Island high school teacher named Tony Cicale. Cicale set the racing world on its ear two years ago with a 2-liter car which was faster than most 5-liter racers, and he's now become the consultant to several other teams.

Ground-effect cars

Cicale's cars look very much like those old Porsches, except that the rear wheels are covered with flush fender skirts, and the entire body is totally devoid of extraneous protrusions which might disrupt the boundary layer adhesion. Air enters the nose through a small opening in the area of highest pressure and exhausts from the hood and fender tops. The addition of this relatively high-pressure air into the stream flowing across the flat top of the body creates such streamlined flow that the low-pressure area normally

(Please turn to page 160)



GM's experimental Aero-X car is based on Citation chassis, has room for four adults and has a Cd of just .295. Note the use of the Kamm tail and flush wheel covers.

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SEARCHING FOR THE PERFECT .10

(Continued from page 159)

found above the body is moved to the rear, behind the car.

This large low-pressure area literally sucks the high-pressure air from beneath the car—and that's the secret of Cicale designs. The body itself is contoured like an upside down airfoil—flat on top, with a full belly pan curving up toward the rear on the bottom. As a result, the entire car develops significant negative lift and is literally pressed to the road by air pressure.

Realistic wind tunnel

Unlike an airplane, a car isn't flying in undisturbed free air, but skimming across a ground plane. The air is actually in shear between the moving car and the apparently moving ground. Traditional aerodynamicists like Dr. Kamm had no way of measuring the "ground effect" on air under the car, so they simply ignored it. Indeed, the first wind tunnel which can truly duplicate the effect of a moving vehicle has just been built by Dan Gurney's All American Racers team. The AAR wind tunnel has a treadmill moving in scale with the wind, to duplicate the effect of a car zooming over the ground. This moving ground plane produces totally different data from a normal wind tunnel.

Racers willingly sacrifice low drag for high cornering forces, with the result that the swoopy-looking new Can-Am cars have a Cd in the neighborhood of .50, no better than Grandpa's Cadillac. But Cd is only part of the story. Frontal area—the size of the surface presented to the wind—is nearly as important. For example, a racer with a Cd of .55 might have only 10 square feet of frontal area, so its "drag factor" is 5.5 ($Cd \times A = \text{drag factor}$). A big sedan might have a Cd of only .50, but typically, a frontal area of 30 square feet. So its drag factor is 15.

Aerodynamicists will be using every possible trick to improve air penetration, from simple remedies like reducing frontal area by making cars smaller to complex ground-effect and zero-lift designs. Already, the new line of General Motors J-cars have Cds around .36, significantly better than the .42 of the X-bodies. Even more impressive, Mercedes-Benz has a new line of full-size sedans, the 300SD and 380SEL, which also rate at .36. That's just the beginning, of course. Within the decade, look for production cars with a Cd of .20 or less. And that will just be one stop along the way in our search for a perfect .10. **PM**

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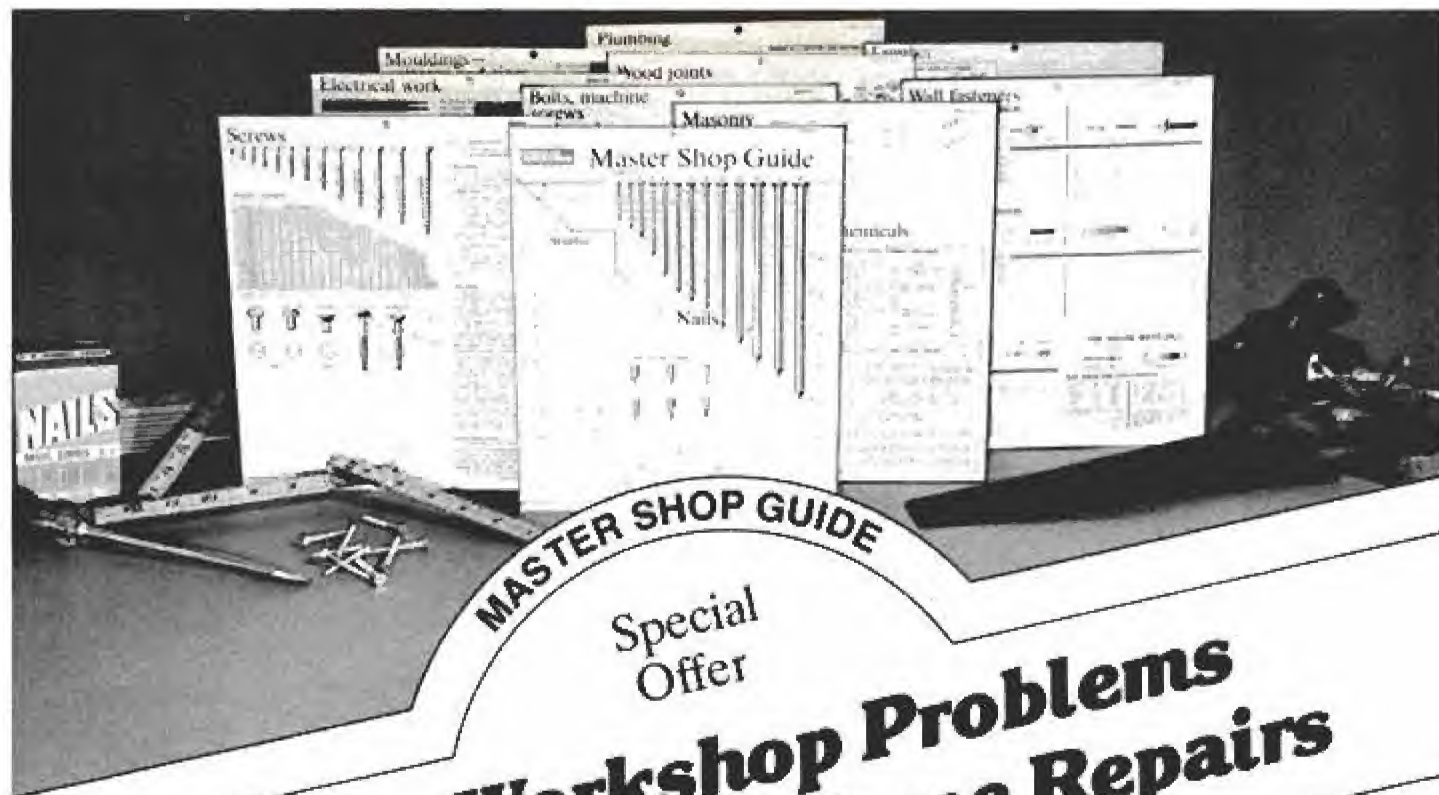
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way it handles on curving mountain roads. Even so, I'd like to see the Starlet go to front-wheel drive, like the Tercel, for better winter traction. Seat construction and the standard recliners are excellent—very comfortable on five-hour trips. The car cruises right along in fifth overdrive. There are only two of us in the family, but there's plenty of room in back for the Doberman pinscher."

A Wisconsin bank executive: "About the only change I'd recommend would be to put vent windows in front and to reduce the road rumble somehow. It's not a quiet car. But for gas mileage, style, roominess, quality and resale value, the Starlet has no peers."

A Texas sales representative, who drives 25,000 miles a year: "I need fuel economy. I traded a 1978 Corolla sport coupe with five-speed—an economical car—but the Starlet gives me 50 percent better mileage. It's very economical, reliable and maneuverable, cruises easily at 60 to 80 mph and never needs service or repairs."

A New York college student: "It handles well under all road conditions, is responsive, tracks true even in sidewinds, and it's well constructed. Very good front seats, although the back seat lacks leg-

room. Good visibility and high fuel mileage. About the only thing they left off was a day/night rear-view mirror, which makes driving after dark very irritating. I made an awfully good deal on this car, though."

A Louisiana insurance processing supervisor: "This is the first new car we have ever purchased that never had a miss, rattle, leak, or some mechanical problem. Toyota has one of the best reputations for



Even six-footers found the back seat of the Starlet comfortable, but egress is hard.

sturdy, long-lasting cars, and now I see why."

A California manager: "Our company offered us Starlets through the credit union, and since I live 48 miles from work, the thought of 50 to 54 mpg appealed to me. The car isn't delivering that, but at 40 mpg, I can't complain. The Starlet also offers excellent maneuverability, it's comfortable, and we've had no problems in six months and 11,000 miles. My only complaint is that it loses power quickly in fifth gear on inclines, but downshifting solves that."

A Louisiana oil-company draftsman: "The airconditioner control button shouldn't slide so easily into the on position. I sometimes knock it on without being aware of it. Also, the speakers with the optional AM/FM radio are the pits. But structurally and qualitatively, the car meets the Toyota standards I had expected, and I like the looks and the gas mileage. My friends and I agree that a well-cared-for Starlet can last a long, long time."

"Getting in and out of the back seat can be a problem," noted an Ohio tool designer, "and an automatic shutoff on the choke would be nice. The Starlet, though, has yet to develop any rattles or squeaks."

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and in 8,790 miles, I haven't had to make any repairs! I'm very impressed with the car's quality and mileage."

A New York math professor: "I like everything about this car. It might be the best I've ever owned. Of course, I thought that about my 1977 Corolla, which I sold to my sister. It's still never been in the shop for anything but regular maintenance."

An Ohio transportation analyst: "I'm 6-foot-3 and have adequate head- and leg-

room. More than that, though, I find the Starlet a solid, well-designed car from the positioning of the engine down to the storage of the tire jack."

The assistant manager of a California auto-parts store: "I wanted high-mileage, low-maintenance transportation without sacrificing comfort. My husband is big (6-foot-3, 230 pounds), and he loves the Starlet. It handles well on the road, has great seats, good visibility, no maintenance, good paint and the seams are all

well finished. I've found no detailing flaws or sloppy workmanship.

"If you asked me what might be improved, I'd say change the airconditioner control. It's combined with the fan, which makes it possible to turn on both at once. That's all, though. I'm proud to drive the car. Thanks for giving me this chance to brag about it!"

Finally, this enthusiastic send-off from a Georgia graphic designer: "The Starlet is my sixth Toyota. What a feeling!" **THE**

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Total miles driven	1,684,519	Needs better materials	5.5	Average	40.2	Two cars	46.5
Average miles per gallon:		What changes would you like?		Poor	23.7	Three cars	12.8
In town	34.7	No changes	15.1%	Had any mechanical trouble?		Four or more cars	6.3
Long trips	42.5	Choke should be automatic	7.1	No	82.2%	Makes of other cars owned:	
Why did you buy the Starlet?		Achieve EPA mpg estimates	6.7	Yes	17.8	Toyota	24.0%
Economy	91.1%	Hidden storage compartment	6.3	What type of trouble?		Chevrolet	21.2
Price	20.1	Supply more engine power	5.6	Carburetor	14.6%	Ford	19.6
Performance	10.0	Workmanship opinion:		Electrical	10.4	Oldsmobile	11.2
Styling	9.7	Excellent	62.0%	Valves	10.4	Buick	8.4
Specific likes:		Good	31.7	Dealer repairs satisfactory?		Age distribution of owners:	
Economy	83.7%	Average	4.1	Yes	64.9%	15-29 years	34.8%
Handling	44.9	Poor	2.2	No	35.1	30-49 years	46.9
Comfort	17.9	Comfort opinion (front seats):		Dealer service opinion:		50-plus	18.4
Styling	14.8	Excellent	37.9%	Excellent	40.7%	Would you buy another Toyota?	
Workmanship	12.5	Good	47.1	Good	34.1	Yes	94.7%
Specific dislikes:		Average	13.2	Average	18.2	No	5.3
No complaints	31.9%	Poor	1.8	Poor	6.0	Would you buy another Starlet?	
Mpg under EPA estimates	14.2	Comfort opinion (rear seats):		Number of vehicles owned:		Yes	82.1%
Noises and rattles	8.7	Excellent	8.3%	Starlet only	34.4%	No	17.9
Engine underpowered	8.7	Good	27.8				

*Percentages might not equal 100% due to rounding or insufficient data.

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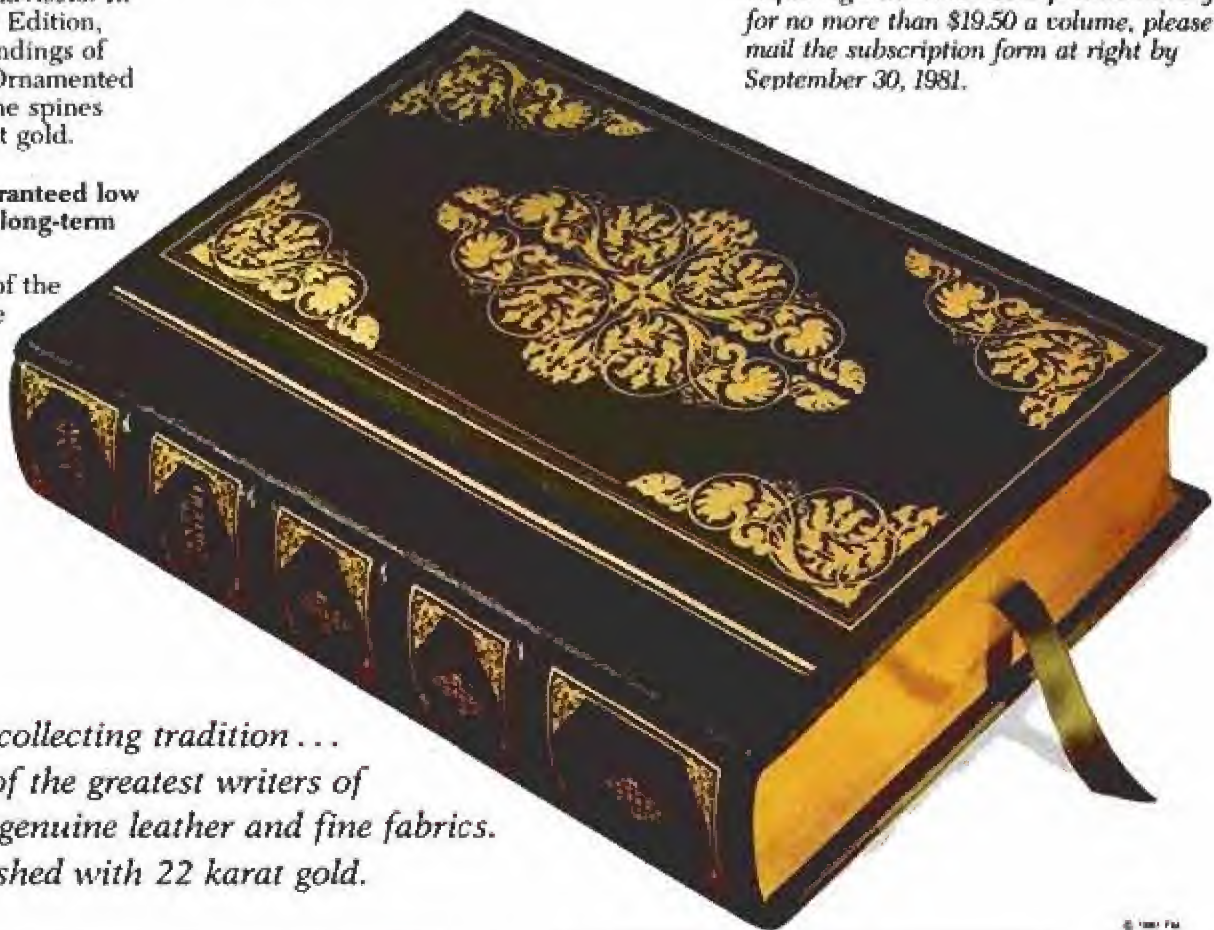
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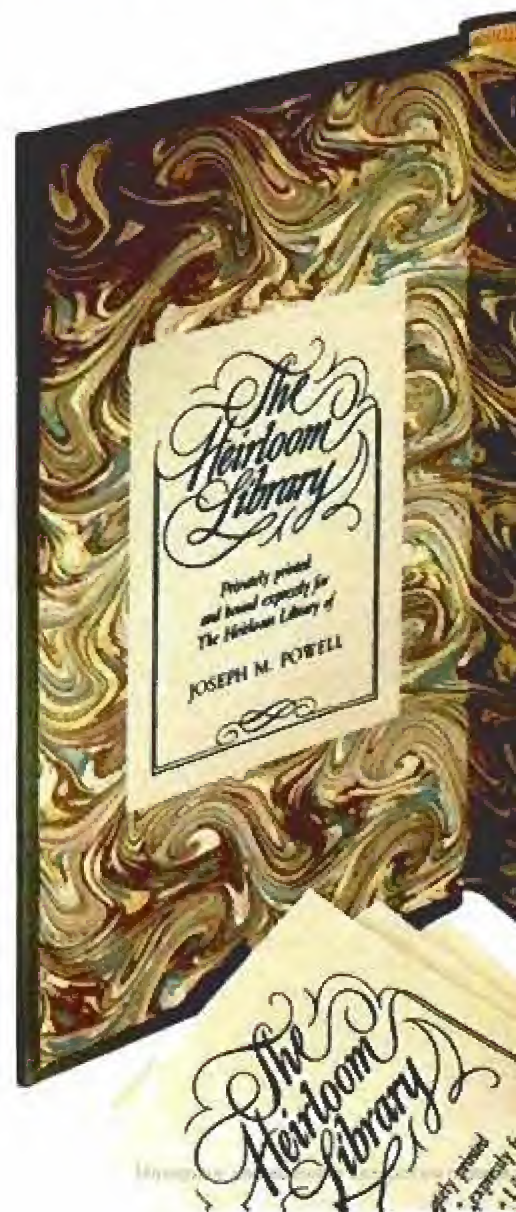


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DETROIT SPINS ITS WHEELS (Continued from page 88)

drives of a hot, new, turbocharged engine that was still under development, then showed us through a book of pictures of next year's beautifully aerodynamic new Thunderbird and "Topaz" front-wheel-drive compacts. It was classified "eyes only" material, unfortunately. Even conservative GM has been freer with future-product information.

This season, the old introductory tradition has all but collapsed. Ford showed its '82 Lincoln Continental, Escort/Lynx five-door hatchbacks, Granada/Cougar wagons and some exciting new power train stuff (see accompanying story) in a series of small, individual magazine previews in May. However, the Continental information and photos were released later (July 31) and the rest will come on September 17. There'll be a normal late-September public introduction for most '82 Ford and Lincoln-Mercury products, but the new wagons may not be available for a couple of months.

Chrysler had a fairly normal preview in June that had auto writers flying in and out for over two weeks. Its '82 fwd, K-based Chrysler LeBaron and Dodge 400, and downsized New Yorker (story next month) also will be launched in September, but availability of some models may be delayed.

With nothing new to show, American Motors elected to skip the summer preview *entirely*, but is tentatively planning a small 4wd Eagle and Jeep press meeting (on the West Coast) several weeks later than normal. Everything will be carryover hardware.

GM's scheduling unsettled

Most confusing of all, largely because much of it is still undecided at this writing, is GM's scheduling. Apparently, the only new products to be launched this fall are a Chevy/GMC minitruck and a series of mid-size "G-car" four-door sedans based on the rear-wheel-drive Monte Carlo/Grand Prix/Cutlass Supreme/Regal—which used to be called A-Specials.

There will be no corporate summer preview at all, though some divisions may show these products to the press individually on a small scale. The really important stuff, fwd X-based A-cars (to replace the conventional Malibu/LeMans/Cutlass/Century) and all-new, very exciting Camaros and Firebirds, may be previewed in August and introduced in December. It all depends on eleventh-hour developments and how long it takes to "build out" '81

models before the assembly plants can be shut down to change them over to the '82s.

All of Detroit's automakers have vowed to introduce at least one new model every six months through mid-decade, so there's plenty more to show between now and next fall. GM will add Olds and Buick versions of its highly praised J-cars along about February, and Ford will kick in its own minitruck to compete with GM's, VW's and the popular Japanese pocket pickups.

Chrysler plans an appropriate spring introduction for its lovely LeBaron convertible (that's right, convertible), LeBaron/600 wagons and Omni/Horizon mini pickups, and AMC should bring in partner Renault's sexy Fuego sport coupe about the same time. Then, come fall, we're in for some real treats in the form of Chevy's all-new Corvette; Pontiac's mid-engine P-car two-seater; Ford's restyled Mustang/Capri; some new fwd luxury sedans from Chrysler; homebuilt AMC/Renault fwd economy cars, redesigned Jeeps and restyled Concord/Eagles from American Motors; and maybe even an all-new Rabbit line from VW of America.

And the hits keep on coming. **PM**

THE '82 FORDS

(Continued from page 89)

room and adequate front-seat adjustment travel for all but the tallest occupants. The rear-drive packaging, however, shows its weakness in footwells that are noticeably cramped between the large transmission tunnel and the inner front wheel housings.

There's also a lack of handy storage bins, shelves or pockets and a not-very-large or usefully shaped glovebox. In the positive column are a wonderful set of graphic and digital electronic instruments, a terrific trip computer and a sophisticated, search-tune, electronic radio, all standard. Also standard are power windows, door locks, antenna and heated side-view mirrors, speed control, tilt steering wheel, illuminated entry system, interval windshield wipers, and twin, six-way, power front seats.

Options include a built-in garage door opener, keyless entry system, eight-track or cassette tape player, power glass moonroof, wire-spoke aluminum wheels and an extended-range, 23-gallon fuel tank (compared to the standard 20 gallons). **PM**

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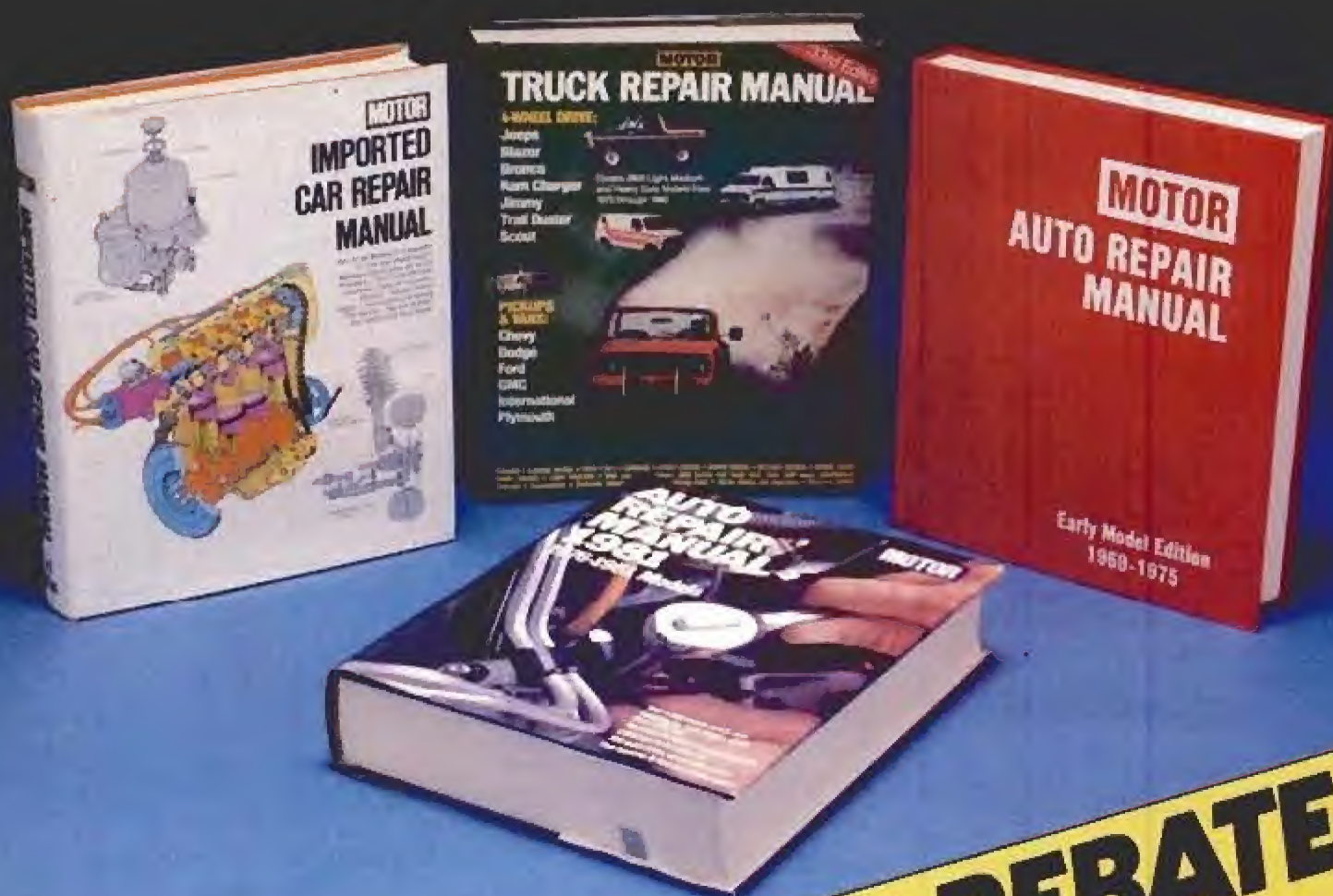
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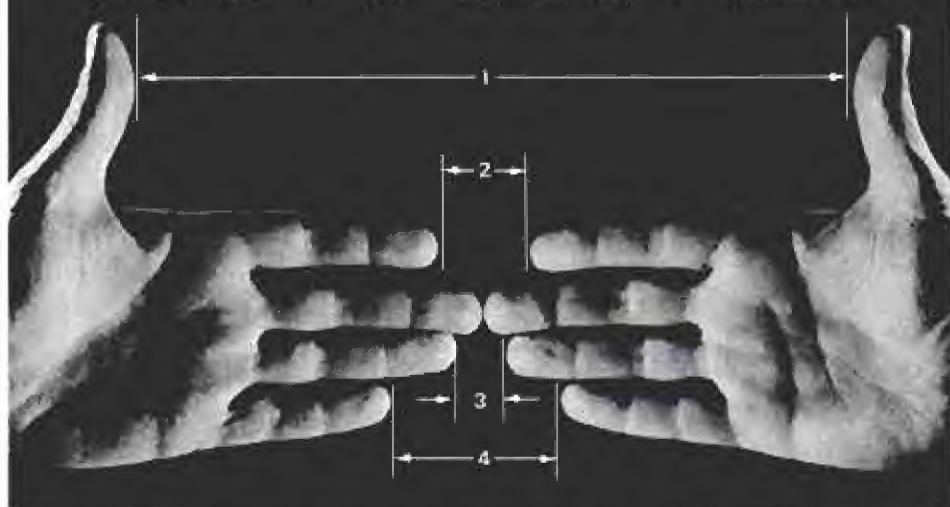
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You're the rule



With middle fingers touching and thumbs stretched, measure 1, 2, 3 and 4 for your hands.

What do you do when you need a quick measurement, but don't have a ruler handy? What if close is good enough, but the consequences of eyeball measurement are less than appealing? Here's a solution: Take the time to "calculate" some of the handiest measurements around—those of your own body.

You can start with your hands. Place them over a ruler (palms up, thumbs stretched, middle fingers touching) and note the dimensions between all opposing fingertips (see 1 through 4). On my hand, dimension No. 1 is especially useful because it's within $\frac{1}{16}$ in. of a foot. The other three are $1\frac{1}{4}$, $\frac{3}{4}$ and 2 in., respectively. Having memorized these, I can quickly hold up my hands to a number of different things and have a good idea of their sizes.

In examples 5, 6 and 7, use your little finger as a stop and record measurements from the edge of a

board to each tip; also the difference between tips. This works just as well if you place your hand flat. Simply catch the fingernail of your little finger below the edge of what you're measuring.

A similar principle operates for Nos. 8 and 9 (below). The middle finger is the stop and by changing knuckles you get two quick reference points. Of course, dimensions on "biophysical rulers" vary depending on the individual. So experiment—find those most valuable to you. With practice, you can be accu-



Butt your little finger to an edge and make three more measurements (see the text).



Make a "gun" of one hand, using the forefinger as the barrel. Fold your middle finger at the third knuckle (above) and then at the second (below). On hand shown we got $3\frac{1}{4}$ in. and $1\frac{1}{2}$ in., respectively.



rate within $\frac{1}{16}$ in. with no trouble.

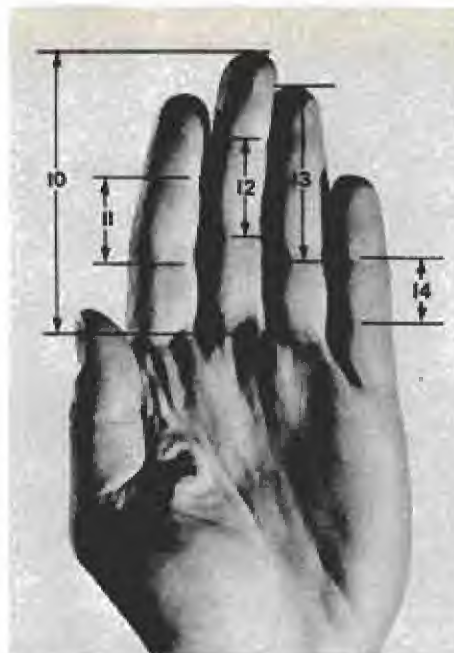
Sometimes you don't have to be measuring anything to use these techniques. They work well as guides for repeating a measurement. For example, if you are face-nailing something where the holes will be filled, but the putty will show, space the nails evenly from a common edge, using your finger gauges to assure a craftsmanlike look.

As you can see (right), your palm also provides valuable measurements, such as those obtained from the creases between finger joints. I know a shopworker who uses a combination of 10 through 14 when sorting accumulated screws and bolts. Even when rulers are available, he finds that his fingers are quicker. He'll even make pencil marks on knuckles for those few increments he doesn't have "on hand."

Larger measurements are also available. The length of your outstretched arm from armpit (or tip of nose) to your middle fingertip is particularly useful, as is the distance between tips when both arms are stretched wide.

Other horizontal measurements come from holding one or both elbows out to your side with your hands on your waist. When both elbows are spread, you can quickly approximate the width of such things as doorways and save the headache of trying to move something big through too small an opening.

For vertical measurements, try the distance between the floor and the tip of your nose, and don't forget to make an adjustment when you change your shoes. The same notion applies to the distance from the floor to your belt buckle or chin.



At least five dimensions are available by simply placing your hand down, palm up.

The possibilities are limitless. Even diameters can be judged with your personal ruler. The difference between tubing sizes can be readily determined depending on which knuckle the tubing jams on when slid over the finger. For example, $\frac{1}{2}$ in. tubing jams on the first knuckle of my little finger, $\frac{3}{4}$ in. jams on the second knuckle and $\frac{1}{2}$ in. clears both.

Larger outside diameters can be known by the combination of thumb and finger that will most nearly encircle them. For still larger diameters, both hands together could supply a ballpark figure.

You can use your hands for close approximations of often used angles (No. 15 below). Make a triangle of your fingers as pictured at left and press it against a table edge. The line that intersects where both fingertips and knuckles meet is perpendicular to the edge of the table, thus giving a 90° angle that is surprisingly accurate. In the process, an equilateral triangle is formed, giving the 60° angles shown.

Finally, by making the old V for victory sign with my middle and first fingers, I get a 45° angle. Of course, these angles and some other measurements mentioned might be something that you'd never use. But, unlike your tape measure, they will always be with you.

—Russell James



By placing fingers as shown you'll have a "protractor" with quick 60° angle and perpendicular line references.



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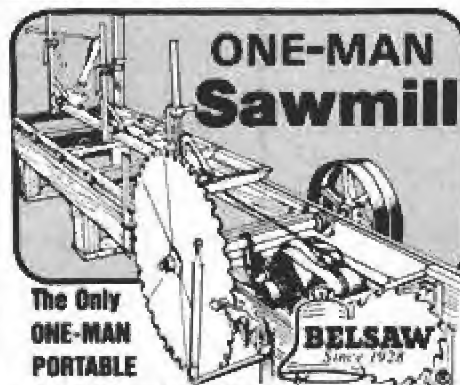
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The big drawing card on Renault's new 18i sedans and wagons comes down to one thing: styling. Not that styling alone sold everyone, but nearly half the 18i owners we interviewed confessed that the car's sporty looks got them interested.

"Styling drew me into the showroom," said a Tennessee physician, "and when I considered the \$4,500 I'd save with this Renault over a comparably equipped BMW 320i or Audi 5+5, I saw no contest."

A North Carolina food handler added, "The 18i's standout feature, in my opinion, is appearance. The body is very sleek looking and stylish."

An Illinois public-relations specialist echoed, "My wife and I wanted a good-



The 18i owes its fine handling to front-wheel drive, all-independent suspension.

PM OWNERS REPORT: RENAULT 18i

looking sports sedan with some style and class. BMW has that same sort of appeal, but it's too expensive."

Not that looks swayed all 18i buyers. A Texas realtor explained, "I bought the 18i because I felt it was an excellent value at \$10,000—the combination of front-wheel drive, excellent fuel economy, plus great interior comfort and space. These features simply aren't available in a comparably priced automobile."

A New York psychologist: "Safety, front-wheel drive, overall economy and total value all became factors, but I think I'd put safety foremost."

And a Minnesota promoter: "The 18i offers a good combination of big-car luxury, sports-car styling and handling, and small-car economy."

That sums up the feelings of a good many 18i owners, who voted overwhelmingly in favor of Renault's polite road manners and thrifty attitude toward fuel. "Economy" and "handling" emerged as the two favorite "likes" of 56.8 percent of our respondents.

On the topic of economy, the EPA's estimated average comes to 25/38 mpg. That's close to the figures our respon-



Sharp styling sold the Renault 18i. It's the French car's single, best liked feature.

dents reported. On the highway, actual mileage ranged from 29.4 to 33.6 mpg, depending on body style and transmission. Ironically, owners with the four-speed posted better mileage than those with five-speeds. This probably means the five-speed's top-gear ratio is too tall and makes drivers put their foot down too hard.

On that point, 12 to 13 percent of our 18i owners felt the car could do with a little

(Please turn to page 182)

A NATIONWIDE SURVEY BASED ON 1,198,675 OWNER-DRIVEN MILES

Owners are generally pleased, but electrical system and dealer service need work

The overall styling pleased most owners.

Owners praised high-quality workmanship.

Ducellier electrical system seemed prone to failure.



PM photos: John W. Lamm

Brakes were cited as being squeaky.

PM LOOKS AT A SUPER LITTLE SANDER

Because its belt measures a mere $2\frac{1}{2} \times 16$ in., you could be fooled into thinking that the belt sander shown is more toy than tool. Nothing could be further from the truth. I quickly learned that the tool's size is an asset. In fact, since the little sander has been in my shop, it's been used on every project I have built. My usual procedure for smoothing wood is to start with a hefty 3×24 sander and coarse abrasive, move to a smaller tool with a 3×21 medium-grit belt and finish with a pad sander.

The tool shown is a gem for finish sanding when fitted with either a fine or very-fine abrasive belt. Other grits are available for tougher chores.—H.W.



Tool is very comfortable in hand and maneuvers easily for sanding steps.



Author found this pint-sized sander especially useful for final smoothing.

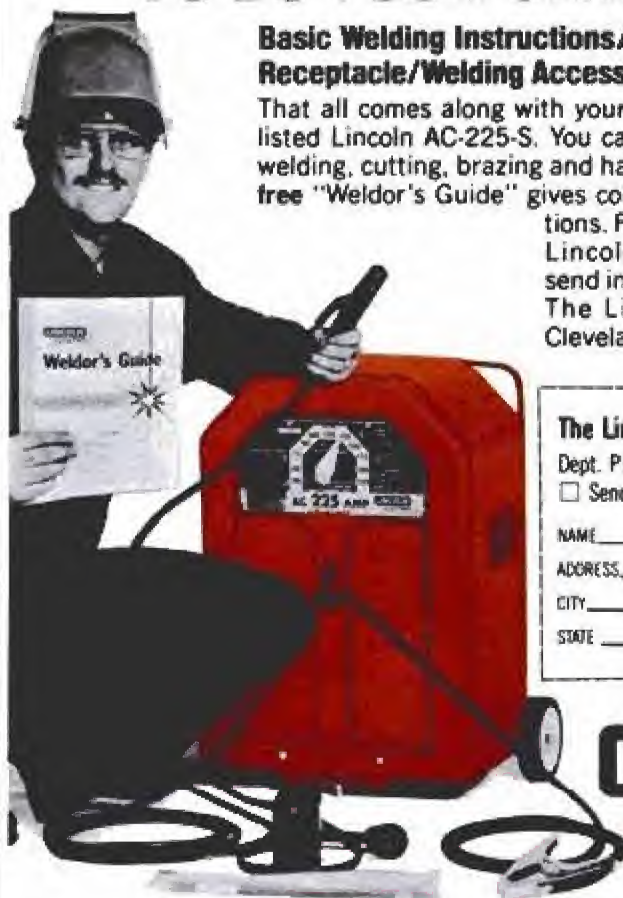
SPECIFICATIONS—SANDER

Model: No. 593 Sandcat
Motor: 2.8 amps., burnout-protected
Safety: Double insulated
Construction: Ball and needle bearing
No-load speed: 600 ft. per min.
Weight: $4\frac{1}{2}$ lbs.
Belt size: $2\frac{1}{2} \times 16$ in. (coarse, medium, fine, very fine)
Price: \$59.99
Manufacturer: Skil Corp., subsidiary of Emerson Electric Co., 4801 West Peterson Ave., Chicago, Ill. 60646

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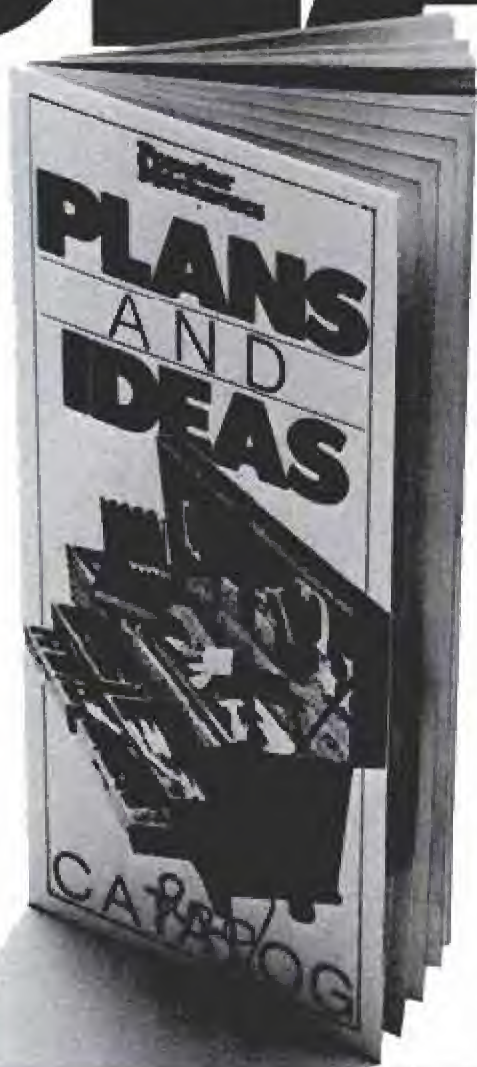
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TECH LINES

Heading for space—from an airport runway

Aerospace

Four NASA researchers recently won a patent on a system to launch future space shuttles horizontally from airport runways.

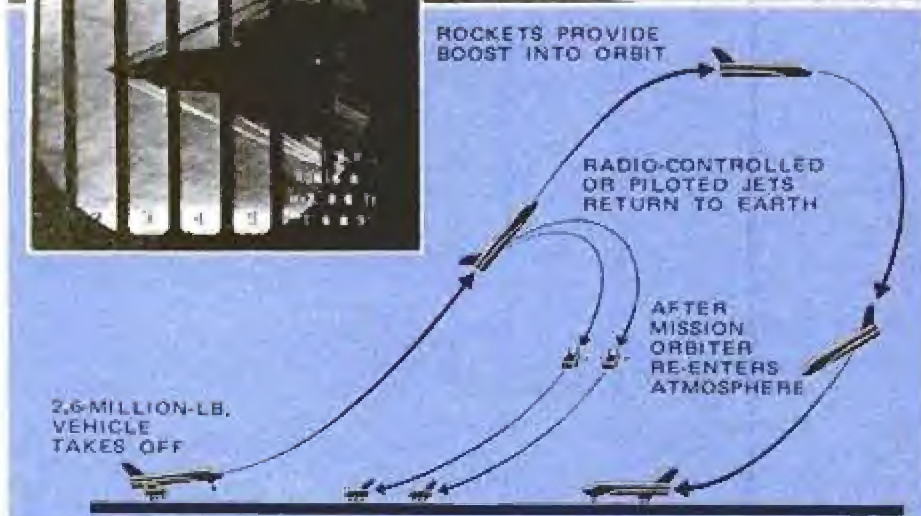
The inventors at Langley Research Center argue that their method will cost less than a conventional vertical liftoff. It would also give the reusable space plane flexibility to leave Earth for space from runways as short as 6,000 feet, a substantial advantage in military applications for the shuttle.

The key element in the complex patent assigned to NASA is the use of two turbojet boosters slung under the orbiter's delta wing. Each booster contains a pod of 8 to 10 engines, burning jet fuel to develop thrust of 100,000 pounds per engine. After a takeoff run of at least 4,150 feet, the plane rises off the runway and assumes a high angle of attack—something over 22°. Some five minutes later, at an altitude of about 50,000 feet, the two jets—carrying human pilots or robotic gear controlled from the ground—detach and circle back for a landing. Every portion of the vehicle can be recovered.

'Tornadoes' aid lift

In wind-tunnel tests of the design, "Everything checked out very well," says William J. Small, one of the inventors. His co-workers are L. Robert Jackson, John P. Weidner and James A. Martin. Small tells us the spacecraft—essentially a biplane at takeoff—gets extra lift from "leading-edge vortexes," which are tight little "tornadoes" of air along delta-wing leading edges. The vortexes improve performance by forcing air to adhere to wing surfaces.

The NASA work parallels research in future generations of smaller, horizontally launched spacecraft, now being conducted at private companies like Boeing Aerospace. Boeing's system involves a shuttle launch from a rocket-powered sled. Research for the Boeing concept was contracted by the Air Force.



Twin jet boosters lift shuttle off runway without use of main rocket engines. Wind-tunnel tests (photo) show concept is

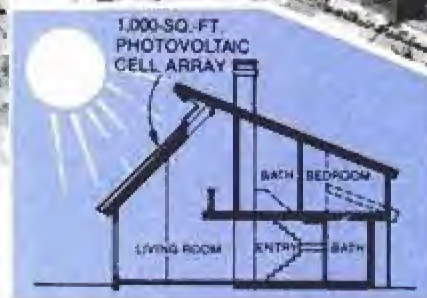
feasible, despite complex "biplane" configuration and multiple shockwaves. After staging, boosters return to runway.

Energy

Tech house retires

How time and technology fly. NASA, embarrassed by barbs of "so what?" from visitors to its experimental energy-saving house in Langley, Va. (*'Our Year in NASA's Far-Out House*, page 77, June '79), closed the home on April 1 of this year—four years and nine months after the opening date.

What was so ho-hum? Active solar collectors, foam insulation, exterior roll-down shutters and a recycled water system. Tour guides were hit with, "We've seen all that. What's really new?" They had few answers. A NASA spokesman said the house will be converted to an office and seminar center.



Photovoltaic cells beneath glazed roof panels generate 9,500 kilowatt hours per year—86 percent of total needs for 3,100-square-foot house in Carlisle, Mass.

The cost of free sun

A built-for-sale house in Carlisle, Mass., fitted with a mass of photovoltaic (PV) cells, reportedly sold for \$325,000 last summer. Though the price was right for its size (3,100 square feet), the figure would have jumped to \$425,000 if the cost of the cells, donated by the U.S. Department of Energy, had been included.

The 1,000-square-foot PV array should produce about 9,500 kilowatt hours a year, a bit more than an average U.S. home uses annually. Excess power will be returned to a utility for credit.

Other savings should result from

an active solar water heater with a 100-square-foot collector. Auxiliary heating units include a wood stove and an air-to-air heat pump.

The house joins a growing number of PV projects around the country (*Raise the (Solar) Roof and Lower Your Utility Bills*, page 144, Feb. '81), all with intriguing technology and daunting costs. But there are signs of a break in the price cloud over PV. Solar Design Associates, Lincoln, Mass.—designers of the Carlisle house—are at work on a new, 2,300-square-foot home in New Mexico which is expected to sell for \$185,000.



Two-foot-diameter fiber flywheel for energy storage in future cars survives speeds of 30,000 rpm in tests at a new Union Carbide lab, Oak Ridge, Tenn.

Adobe in new wraps

(The following report from PM reader Dan Behles of Albuquerque, N.M., describes an interesting blend of old and new technology. Tech Lines would like to hear from other readers about energy-saving projects that have worked for them.)

Gentlemen:

In a high, desert area where the temperatures drop at night, even in summer, an uninsulated adobe wall provides a "flywheel" effect—the heat absorbed by the outside of the walls during the day is released

into the house at night to temper interior temperature swings.

However, in a low-altitude area where you do not encounter the large diurnal temperature fluctuations, an uninsulated adobe wall may not be particularly effective. The solution, and one which improves the performance of the adobe even in high, desert areas, is to insulate the outside of the adobe wall. That is the system my wife and I used in our own-built adobe home here.

Our home was built with 14-inch adobe walls all the way around. We then "wrapped" a conventional,

wood-frame stud house around the outside of our adobe, and filled that with six inches of fiberglass batts. We completed the exterior with standard stucco over asphalt-impregnated sheathing and then we plastered the inside of the adobe walls.

By insulating our adobe from the outside environment, we have lost the benefit of any direct solar gain from the sun striking the walls. But we have created a 150-ton "heat sink" inside the insulating envelope. That giant battery takes a long time to charge up, but once it's warm, it takes a long time to cool off. And

the only place it can lose heat is to the inside of the house.

The house "charges" in three different ways: 1. Direct gain from the sun through southern-exposure windows; 2. Warm air from the greenhouse and from our wood stove; 3. Heated air from the greenhouse forced by fan through an underfloor maze of 2,000 jugs of water.

We have never had to activate the resistance baseboard heaters, which we installed in order to comply with the local building code.

—Dan Behles

Inventions

Flea-sized fleet

An inflatable one-man boat folds into a package hardly bigger than the blade of a paddle.

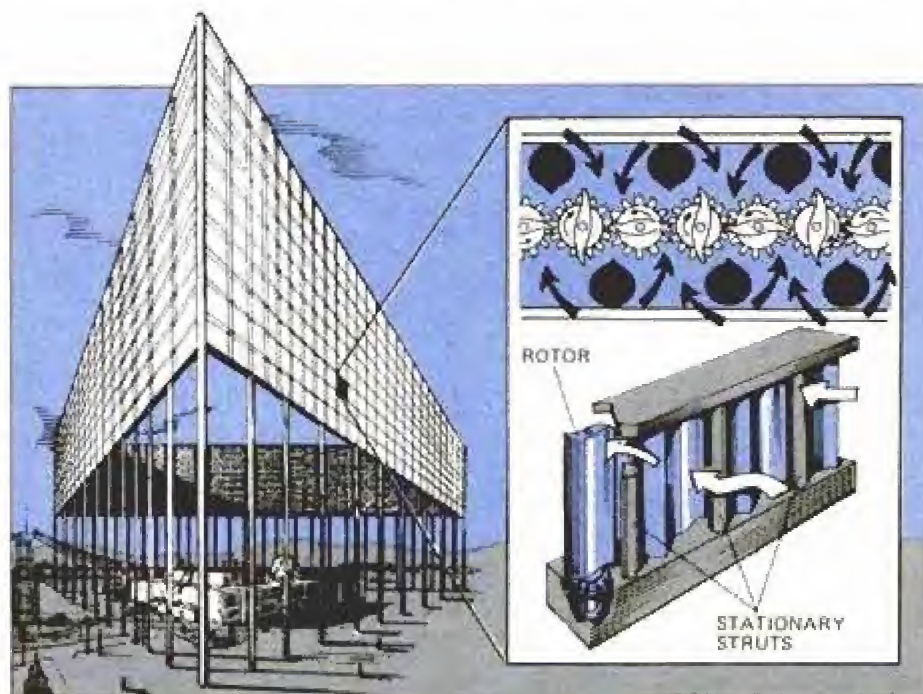
George P. Gillespie, a project engineer at the Naval Air Development Center in Warminster, Pa., invented what he calls the miniboat, for emergency use. The plastic or coated-nylon craft folds into a box 11 inches square and 1 inch deep. The user expands the hull into shape by releasing compressed gas; inflation is completed by blowing through a tube.

The miniboat (Patent 4,268,930) has been put through tests by the U.S. and Australian air forces.

Wind fence

The giant fence atop this page is designed with cracks to let the wind through, so it can turn rotors and generate power.

Harry H. Bahrenburg's invention (Patent 4,265,086) catches wind from any direction, although each rotor always turns in just one direction. The rotors operate pumps which pro-



Stationary struts direct the wind flow so that each rotor spins in just one direction.

pel liquid to a turbine tied in to a conventional generator.

Each fence is made up of dozens of small, interconnected modules. At sites where the wind shifts regularly by 180 degrees—at the seashore, for example—the fence would be a single, straight barrier. Where winds blow erratically, the fence could be

built as a multisided wall, like the one shown above.

Bahrenburg has not yet carried the idea beyond the small model stage. But his dream is to design huge wind structures up to 500 feet high and five miles long or to construct his energy-catching fences on top of urban skyscrapers.

Automotive

GM coal-burner

The idea of burning coal to power a car isn't new. But only recently, due to im-

proved techniques of refining coal, has it become practical.

GM has been working on this system and it's finally come up with something that works. The coal-burning car, called AGT-5, uses

a GM turbine engine which has been around for 30 years.

Previously, coal could only be powdered to about a 50- to 75-micron particle size. But with improved mechanical and solvent refining techniques, scientists can break the coal down to a 3-micron particle size—just the right size for burning in a turbine.

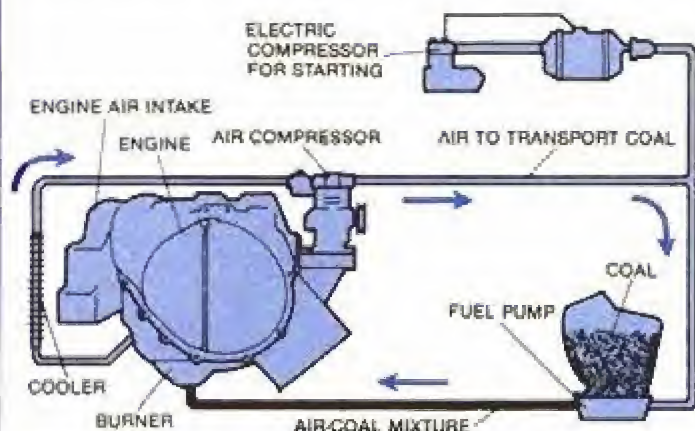
The fuel tank in this car is nothing more than a bag containing powdered coal; the delivery system is an air pump that blows the coal to the engine in a continuous mist.

The engine has a small, liquid-fuel tank which is used to fire up the engine initially. After startup, the liquid fuel is shut off and the engine runs only on the powdered coal.

So far, tests have shown that the car performs like a conventional small-block V8 with fuel consumption equivalent to that of an '81 car.

Using powdered coal rather than a liquid fuel derived from coal is more desirable, according to GM, because the powdered fuel yields 80 percent of the coal's energy potential. Liquid fuel made from coal yields only about 55 percent of the coal's total energy potential. It's also cheaper to powder the coal than to refine it into oil.

GM slide rules are still trying to figure out the street value of the powder. GM estimates the powdered coal costs one-third the price of gasoline on an equivalent B.T.U. basis.



GM's AGT-5 powdered-coal-burning turbine engine yields the equivalent power and fuel economy of a current V8 engine.

Electronics

Superbattery

One of the bumps in the road on the way to an affordable electric car is the bulkiness of today's lead-acid battery. Now, General Electric says it may have found a shortcut around the bump: an agreement with a British firm to jointly develop new, weight-saving superbatteries.

The goal of the agreement with Chloride Silent Power Ltd. of Great Britain is to cut years off the time it will take to produce the superbattery. The partners should be ready by the mid-1980s, GE says, to demonstrate a sodium-sulfur "beta" bat-



Scientists ready laboratory-sized, high-powered sodium-sulfur cell for testing.



Genesis Exercise Computer (\$159.95, Biometric Systems, Marina Del Rey, Calif.) monitors wearer's heartbeat and warns if the rate goes too high.

tery in action. Studies suggest that the beta will store more than four times the energy of conventional batteries of equal weight. And its projected life exceeds 2,500 charge-discharge cycles—enough for at least five years aboard an electric-powered car.

Traveling typewriter

A little, five-fingered keyboard now being tested at Stanford University may change the way people type. It's an electronic word processor that hooks up to a video display and allows you to type one-handed. The "Microwriter" stores up to eight pages of text in memory and lets

users insert and delete letters. Then, it can be attached to a printer for hard copy.



Researchers at Stanford say nearly anyone can learn to use Microwriter in 30 minutes.

Medicine

Look ma, no braces

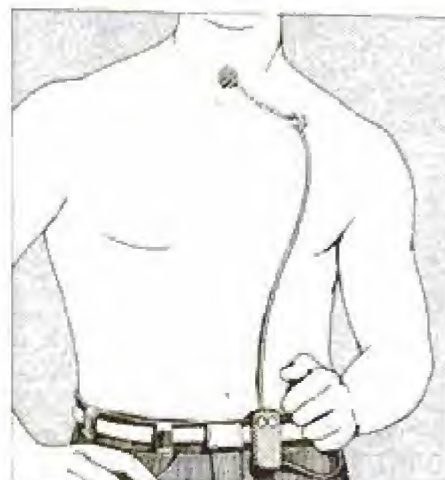
Maybe it won't be long before clunky metal braces for teeth will be just a memory. At the annual orthodontists' meeting this year, Dr. Kinya Fujita of Kanagawa Dental University, Japan, unveiled corrective braces that attach to the back of teeth. The inventor says the braces won't be released commercially "for some time."

Artificial larynx

To date, people without a larynx "talked" through a battery-operated squawk box held against the throat.

Users found that it was awkward to operate.

That's going to change. Researchers at the University of Toronto have found a way to implant an artificial



To talk, user pushes button sending electrical signal from oscillator to larynx.

larynx at the back of the throat. A pocket switch activates the device, powered by a belt-slung battery pack. The device produces different frequencies for men and women, and can be set to emit a rising tone when its user wants to ask a question. "The implant still doesn't produce a human voice," says Dr. John Fredrickson, a medical researcher with the University, "but it's a big improvement."

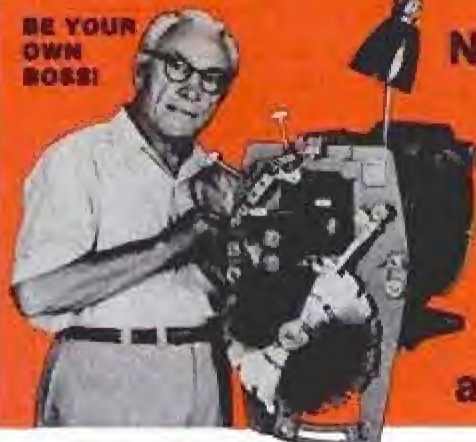
Hirsute hazard

Beards undermine the purpose of protective face masks—filtering out fumes, dust and fibers. Bearded users get more than a whiff of toxic particles, says the Swedish National Defense Research Institute. The group found that masks don't fit well on a shaggy or stubbly face. The Institute's advice to men wearing a mask: To save yourself, shave yourself.

Editor: Gurney Williams III

Contributors: Tony Aseneta, Dan Behles, John Ingersoll, Stacy V. Jones, Neil L. Shapiro

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William Wescott
Willoughby, Ohio 44094



**Husband and
wife have a
going spare
time shop**

"I'm a construction foreman, and my wife is a nurse's aide. Our Foley shop fits in nicely with our regular jobs, and we earn extra money. Our sons help out too, so ours is a real family business."

"I'm still too young to retire, but when I do I'll have a very good business built up. Foley equipment helps us to do good work and brings customers back with more jobs on a regular basis... we have a lot of repeat business the year around."

Victor Kosloski
Sturgis, Michigan 49091



**Glad he
chose Foley
for his saw
shop**

"I worked as a carpenter all my life, but when a back injury forced me to quit I decided to go into sharpening full time. I'm very proud of my shop and glad my choice was Foley equipment... it is superb. I made over \$48,000 last year, and this year it will go more than \$50,000."

Victor Johnson
Lincoln, Nebraska 68507

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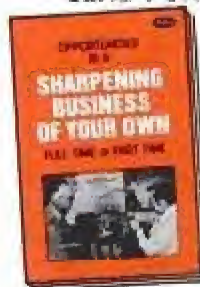
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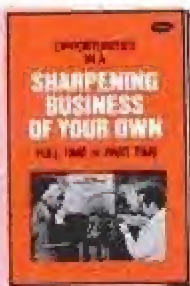
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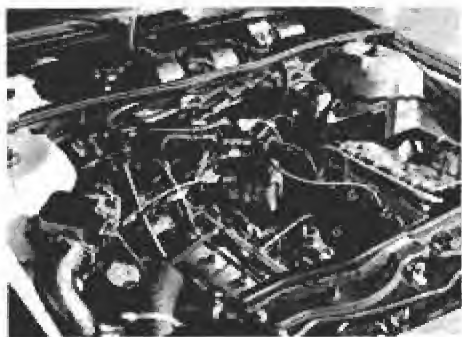
PM OWNERS REPORT: RENAULT 18i

(Continued from page 172)

more horsepower. A self-employed Californian put it this way: "The engine feels a little weak. I wish Renault would offer a turbocharger." As it happens, the 18i can be ordered with a turbo in France.

On the handling front, the 18i garnered considerable praise, eliciting comments like, "handles well over rough roads, of which we have plenty."—New York machinist. Another New Yorker observed, "Front-wheel drive gives good traction and handling on ice and snow." A Georgia banker: "Perfect balance makes maneuvering in traffic easy." A Kentucky housewife: "Feels solid and good on the road. I love to drive it!"

Nor did riding comfort suffer as a consequence of handling. Drivers generally agreed that the 18i's suspension has a pleasingly compliant feeling without the jiggleness associated with short-wheelbase, "handling" cars. "It's very French,"



The 1.6-liter, fuel-injected engine produces 82 hp, but some owners feel it's too weak.

mused a student from North Carolina.

A California bank officer noted, "... seats are very comfortable. I'm 6-1, 240 pounds and have lots of room. The Renault's riding qualities are such that I don't tire, even on two-to-three-hour trips."

A New Hampshire millworker added,



Plush, high-quality interior gets raves, but the steering wheel angle is too vertical.

"These seats feel better than those in my previous Cadillac." A Wisconsin personnel director: "Front seats are the most comfortable I've ever experienced. There's plenty of support for the lower back, and I make good use of the seat-back adjustments on long trips."

When we asked for comments on the Renault's quality and workmanship, we logged another wave of compliments. Eighty percent of our respondents rated workmanship *good to excellent*. An Illinois tax accountant told us, "This is my first import, but no Detroit car I've owned has had anywhere near the quality exhibited by this Renault."

A retired college professor from Ohio: "I've looked closely, but have seen no evidence of shoddy workmanship." And an Illinois college instructor: "Quality compares favorably with Audi and Mercedes."

Even so, when we asked for specific complaints, 17.8 percent of our owners cited noises and rattles. Squeaky brakes fit into that same category and were mentioned by 8.7 percent of 18i owners. "Plastic parts of the dashboard rub together and squeak on rough roads," said a North Carolina microbiologist. A New York chemical executive: "Brakes are noisy and squeak all over in cold weather." Another self-employed Californian: "There's some engine/chassis vibration and road rumble at 55 to 65 mph."

AMC's continental cousin

Renault now owns 46 percent of AMC, which means that this time, the French car-maker holds more than a temporary U.S. visa. And as the two companies merge and pool their talents, we'll probably see their product lines begin to mesh.

Right now, though, the Renault 18i nearly overlaps the AMC Spirit in terms of general size. Wheelbases are 96.1 and 96.0 inches, respectively. Yet the two cars are separated by nearly \$2,500 in base price. And the 18i faces an entirely different market than the Spirit—one that includes the VW Jetta/Dasher, Saab 900, Audi 4000, Mazda 626 and, at the upper end, the BMW 320i and Cadillac Cimarron.

The 18i boasts such engineering highlights as front-wheel drive, electronic fuel injection, rack-and-pinion steering, steel-belted radials, adjustable reclining seats and a vast array of thoughtful design details.

The 82-hp, 1.6-liter, pushrod Four mates with a four-speed gearbox; an automatic or five-speed is optional. Also available are leather interior, electric windows and door locks, airconditioning and the usual power assists.

Renault engineers have given special attention to the 18i's safety and aerodynamic details. Extra beams and gussets protect the passenger compartment and the 18i's "aero" number is 0.40 (drag coefficient) which isn't half bad for a sit-up-straight sedan. Speaking of numbers, the EPA gives the 18i a 25/38-mpg rating.

A California inspector: "The transaxle whines at higher speeds."

A higher-than-average number of owners reported mechanical problems with the 18i. Some were quite minor, such as the speedometer reading fast, but others touched on major problem areas. Of those, the electrical system came in for the most criticism, such as "... that X#@c ignition short!" A number of owners said their cars simply quit running; others returned to parked cars and found

(Please turn to page 184)

SUMMARY OF 1981 RENAULT 18i OWNERS REPORTS*

Total miles driven 1,198,675	Front-wheel drive 19.1	Average 9.0	Dealer service opinion:
Average miles per gallon:	Handling 16.1	Poor 3.0	Excellent 24.6%
Four-speed manual	Specific likes:	Comfort opinion (front seats):	Good 36.8
In town 26.6	Handling 56.8%	Excellent 64.1%	Average 21.1
Long trips 33.6	Economy 56.8	Good 29.5	Poor 17.5
Five-speed manual	Styling 48.2	Average 6.0	Number of vehicles owned:
In town 25.4	Comfort 45.5	Poor 0.4	Renault only 34.1%
Long trips 32.8	Riding qualities 24.3	Comfort opinion (rear seats):	Two cars 47.0
Three-speed automatic	Specific dislikes:	Excellent 29.7%	Three cars 13.8
In town 23.6	Noises and rattles 17.8%	Good 40.2	Four or more cars 5.2
Long trips 29.4	Not enough power 13.7	Average 25.1	Makes of other cars owned:
Transmission choices:	Poor dealer service 13.7	Poor 5.0	Chevrolet 21.1%
Five-speed manual 49.8%	No complaints 11.4	Had any mechanical trouble?	Ford 11.8
Three-speed automatic 36.9	Squeaky brakes 8.7	Yes 64.5%	Volkswagen 9.9
Four-speed manual 13.3	What changes would you like?	No 35.5	Oldsmobile 9.9
Body-style choices:	More horsepower 12.6%	What type of trouble?	Renault 7.9
Four-door sedan 85.8%	Fewer rattles and noises 7.9	Electrical and alternator 25.5%	Age distribution of owners:
Five-door wagon 14.2	Relocate ashtray 7.0	Brakes 10.1	15 to 29 years 22.9%
Why did you choose the 18i?	No changes 6.5	Heater 9.4	30 to 49 years 50.7
Styling 45.2%	Silence squeaky brakes 5.6	Airconditioner 7.4	50-plus 26.4
Economy 39.6	Workmanship opinion:	Dealer repairs satisfactory?	Would you buy another 18i?
Comfort 20.9	Excellent 38.9%	Yes 53.5%	Yes 60.0%
	Good 49.1	No 46.5	No 20.0

*Percentages might not equal 100% due to rounding or insufficient data.



1981 U.S. GOV'T REPORT: CARLTON LOWEST.

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Box: Less than 0.01 mg. "tar", 0.002 mg. nicotine av. per cigarette by FTC method.
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That Cigarette Smoking Is Dangerous to Your Health.

they couldn't start the engine. Alternators and the alternator wiring harness tended to go bad, and minor electrical problems affected the clock, heater, air conditioner and interior lights. In all, 64.5 percent of 18i owners experienced mechanical difficulties of one sort or another.

Renault owners weren't overly enthusiastic about their dealers either. "I bought this car figuring I could have it serviced by AMC dealers nationwide," wrote a Wisconsin retailer, "but I was very disappointed to find that most AMC outlets have neither the knowledge, tools, nor parts to repair my 18i."

A Georgia computer operator seconded: "I hate American Motors for not providing tools to their dealers before selling these cars!" A Delaware executive: "I had six initial complaints, ranging from gas fumes to poor body seals. I've been back to the dealer seven times, but he's been unable to correct any of my problems!"

When we asked for suggested improvements, 18i owners offered the following. An Ohio store manager recommended, "Less engine boom at highway speeds; stiffer rear suspension; smoother shifter." A Montana home salesman: "I wish they'd offer a diesel engine." A New York warehouseman: "With the five-



Rear-seat comfort is very good, but entrance and exit caused some complaint.

speed transmission, the shift lever makes the ashtray hard to get at." A Nebraska school counselor: "Ignition switch is hard to reach, and the stalk-mounted controls for horn, light, wipers, etc. keep going on and off when I don't want them to."

Other suggestions included moving the muffler and catalytic converter back along the exhaust pipe to lessen engine roar; a

less horizontal steering-wheel position; and less interior plastic.

But despite all this mild grouching, most Renault 18i owners expressed great pleasure and satisfaction. A California electrician beamed, "I love everything about this car and find myself smiling at every opportunity to drive it."

An Illinois camera salesman: "I would recommend the 18i to anyone. This Renault is my 90th car in 16 years. I've owned about everything you can name, and the 18i is one of the best."

A Tennessee salesman: "I really like the Renault 18i and am glad I bought it. As an insurance salesman, I drive more than most people. I find this one of the most comfortable cars I've ever been in."

An Arizona homemaker and student: "The car has a lot of styling inside and out, and more quality and standard features than you'd expect for the money."

Finally, a California attorney sums up the 18i in these words: "Where else could you find such excellent exterior styling, high-quality workmanship, responsive handling, good gas mileage, and relatively high performance? Compared with other autos, space utilization and seating are superior, as is the 18i as a whole."

—Michael Lamm



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A double-barreled delivery of high performance and high mileage.

by Gary Witzenburg
DETROIT AUTO EDITOR
and Rich Taylor

Though the Audi Coupe looks like something from the world-famous Ital Design studio of Giorgetto Giugiaro, the sexy, wedge-shaped body was created by Audi's own stylists in Ingolstadt, West Germany. It debuted last year on the high-performance, four-wheel-drive Audi Quattro.

It features a functional, wrap-around front air dam, a rear spoiler and a 60° raked windshield, and boasts an impressive drag coefficient of 0.39. With the standard five-speed transmission, the Coupe accelerates from 0 to 60 mph in just over 10 seconds, yet delivers 21 mpg city and 36 mpg highway in EPA mileage testing. Equipped with an automatic, its economy drops to 20 city, 28 highway; 0 to 60 performance to 13 seconds.

Front suspension is MacPherson struts, with special, steel-reinforced rubber bushings for improved directional control. In the rear, Audi's

excellent torsion-crank rear axle, supported by coil springs, has its pivots raised nearly an inch (compared to the regular 4000) for better steering response and less body roll during cornering. Shock absorbers are stiffened slightly all around, and rebound control is specially tuned to what Audi considers the best ride/handling compromise. Brakes are the usual front disc, rear drum combination with a standard power assist.

The bottom line is a precise-handling automobile that can be driven hard and fast with great security on twisty, rural two-lane roads. Combined with power rack-and-pinion steering and low-profile, high-performance tires on 14×6-inch alloy wheels, the suspension gives probably the best front-wheel-drive handling we've experienced short of VW's smaller Scirocco.

Every situation we encountered

(Please turn to page 192)



Though not as sharply styled as the Coupe, VW diesel Jetta yields an admirable 57 mpg EPA highway. Even better is the fact that you can match this EPA number on the road.

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Keep your records sounding new

Record-care products are better than ever, and take advantage of some real state-of-the-art technology.

by Bill Kanner

This may look like a record being eaten by a shark, but it's really the Vacorec from Vor Industries in operation, whisking dust away from a disc.



Manual antistatic generators look like futuristic ray guns and work as the trigger is pumped back and forth. But they do carry a good charge; so don't point them at anyone. The ones we show are: 1. Robins' Rob-O-Stat; 2. Discwasher's Zerostat; 3. Empire from Audio Groome.



The Kilavolt antistatic generator from Nagoka (left) works off battery with just the push of a button.



Placed on center of record, a heavy stabilizer, such as this one from Nagoka, will help stop warping.



Record-care hardware, such as the "Scotch" system from 3M, will help you protect your records from damaging static and oils.



The PDQII system from Audio-Technica will guard both your records and your turntable's stylus. Parts are also available separately.

Record care has grown, from a small industry selling mainly treated cloths, to giant companies using space-age technology to guard discs against nicks, scratches and static. Along with the new ways to take care of records has come quite a bit of confusion over which method is best for which problem. There's even some question about how some

of the more esoteric products work.

Perhaps the best known device is the Discwasher, which has spawned many variations. The Discwasher is a directionally textured, plush pad mounted on a handsome wood handle. The pad is wetted with Discwasher's D3 solution and drawn around the record, tracking the grooves. As you brush the record,

dust is swept up into the soft pad.

The variations include the liquid used to loosen the dirt, which can range from water to multichemical and antistatic formulas. Among the companies that produce this type of preener device, you'll find Watts, Recoton (whose Clean Sound II has replaceable pads) and Audio-Techni-

(Please turn to page 190)

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(Continued from page 188)

ca (whose Sonic Broom has a brush cleaner). Robins' Whiskee and Sound Saver's Classic I have a cavity in the handle for the cleaning solution, as does the Discwasher.

Sprays

While most of these devices have some sort of fluid to aid them, the basic item is really the wiper or brush. However, there is a group of products for which the reverse is true. You still squirt or spray a product onto a record or pad, but you *buff* in the substance rather than wipe up the dirt. The application is more important than the applicator.

Sound Guard is probably the most widely known of these products. It is a lubricant product of space-age technology. Its major feature is that it forms a chemical bond with the vinyl record groove and locks out dirt and grit; it also acts as a lubricant to reduce the friction of the stylus in the groove.

Audio-Technica's Lifesaver is a similar pump-spray product. However, it contains not only a record preservative/lubricant, but a cleaner, as well. The same can be said for Stanton's Permostat. If you prefer a full spray, Quietone, from Hammond Industries, is one that has a preservative/lubricant and antistatic agent.

Ionic neutralizers

If you find you have lots of pops and clicks, symptomatic of static electricity, on your discs, you may want to try one of the solely antistatic products on the market. Again, the best known is probably from Discwasher, the Zerostat. There are a number of versions of this pistol-shaped device on the market. A slow squeeze of the trigger over the disc and static-neutralizing ions are released over the record. Empire and Robins have similar items. However, these products do produce a voltage and carry warnings not to aim at people and to keep out of the reach of children. Watts has a device that operates on the same principle, but is shaped like an oversized cigaret lighter instead of a gun. Osawa's Kila-volt is another ionic antistatic product. It is shaped something like a paint scraper and, unlike the other products mentioned, requires a "C" battery.

Antistatic sleeves and mats

Once you've taken the trouble to remove static from your disc's surface, you will want to keep the static charge down. Empire and Discwasher are among the companies that produce antistatic, felt-type mats.

Since a static charge can be created simply by removing a disc from its sleeve, Discwasher and Empire, among other companies, have developed antistatic record jackets. Discwasher's VRPs are just the plastic-type sleeve, while Empire's is a paper sleeve with the plastic inner lining. Both come in packages of 10.

Facials and vacuums

Empire's Disc-O-Film is a facial for records. While it contains an antistatic ingredient, its primary function is deep cleaning of record surfaces and grooves the same way a standard facial removes dirt and oil from the skin. The application is similar, too. Just squirt the goo on the record and wait (usually 45 minutes to an hour) and then just peel the hardened film from the disc. Along with the preparation should come all of the dust, dirt and grime you've let accumulate.

If the hour wait is too long for you, try vacuum-cleaning your records before you play them. Vac-O-Rec (now part of Robins) has two models on the market that

do just that. The Model 100 first appeared a few years ago. It's a device that looks a little like a shark's jaw. You place the record in the groove (the shark's mouth), turn on the machine and the record is rotated and both sides are vacuumed clean. The deluxe and stronger model is the 1100. It's a more conventionally shaped, rectangular affair and it comes with a washable filter, improved static grounding and a larger motor for more suction.

Cleaning the needle

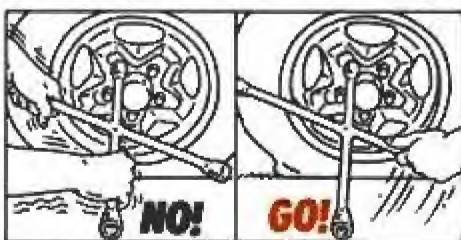
Your stylus should be kept clean and your turntable level. A clean stylus will not push and grind dirt into the grooves of a clean record and a level turntable won't turn your diamond stylus into a Grade-A cutting tool. Stylus cleaners are also widely available now. Watts, Discwasher and Robins are among the companies marketing devices to clean your diamond. The Watts stylus cleaner is a soft pad mounted on clear plastic. Discwasher's SC-1 is a brush on one side and a magnifying mirror on the other, all encased in a walnut handle. The SC-1 is designed to be used with Discwasher's D3 solution. Robins offers an entire kit including a brush, small screwdriver (for cartridge hardware), stylus microscope and stylus cleaning fluid.

To check if your turntable is level, there are several devices around, from the simple, round bubble level frequently available by itself or in a kit with adjustable turntable feet, to a T-level from Robins. The T has a spindle hole and the device works like a carpenter's level.

The newest and most unusual set of devices are the stabilizers. Available from several companies, these heavy weights are designed to fit over the label area of your record and on the spindle. Many records arrive already warped, and the heavy weight will tend to flatten them for the time they are on the turntable. The weight also reduces the air between the disc and the mat, thus lessening turntable resonance. Another effect is that the added weight gives more oomph to the flywheel effect generated by the turntable platter, which is said to decrease flutter. Osawa's GL-601 has a built-in strobe and a ball-bearing level to check speed and level. Another product sold to reduce the effect of record warp is Warp Out. It's a metal ring designed to fit over the outer edge of the disc and keep the record in full contact with the turntable mat. While it fits many turntables, it does require that the platter not extend beyond the 12-inch edge of the disc.

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FIRSTHAND REPORT

(Continued from page 185)

in a long day's test driving through the hills of Virginia and West Virginia was handled with aplomb and no unwelcome surprises. The only negative ride characteristic was a bit of "floatiness" at moderate to high speeds on undulating surfaces.

Inside are high-bolstered sport seats in cloth or (optional) brown leather with open, rectangular headrests. Rear seats are body-contoured with integral head restraints, and there's room in back for three adults, if they know each other well.

An instrument-panel tachometer (with clock), the console-mounted gauges, remote-control outside mirrors, cruise control and leather-covered sport steering wheel and shift lever are standard. There's a driver's seat height adjuster and enough rearward travel for the average NBA center, and there's an extra padded hood over the instruments to prevent reflections.

It's not a hatchback

On the other hand, the coupe's interior lacks the typical German penchant for providing convenient storage space (no console bins or boxes, no partitioned dash-top shelf area).

The optional steel sunroof pops up or removes but doesn't slide open, and rear visibility for backing in tight quarters is cut off by the body's high flanks. There's no rear hatch to make it a mini-wagon, but the trunk



Based on the 4000 sedan's suspension, the Coupe's has been upgraded for better handling. It has MacPherson struts up front and Audi's unique, torsion-crank axle in the back.

holds an impressive 17 cu. ft. of cargo. The long (for an import car) option list includes airconditioning, power windows, door locks and mirrors, rear window wiper, metallic paint, AM/FM stereo with cassette player and even heated seats.

The 4000-based Coupe may be the latest and among the greatest from German automaker Audi, now celebrating its 50th year of producing high-technology fwd cars, but there's much more to come in the next few years.

Be on the lookout for a turbo-charged diesel engine option in the near future, and probably a U.S.-spec version of the mighty 4wd Quattro.

Porsche-Audi Div. of Volkswagen of America sure seems to enjoy throwing gauntlets at the American industry.—G.W.

Diesel Jetta and Rabbit

Forty-six miles per gallon, flat out? Eighty mpg, if you try? Impossible. But not in a Volkswagen diesel, as we proved in an all-day drive through New England. Fourteen cars full of journalists rallied for an economy run, some driving the new Jetta Diesel, some Rabbit Diesels. The winners averaged 79 mpg, with a top leg of 84.5 mpg.

As you might expect, these figures aren't representative of what you'd get. Tires inflated to 45 pounds per square inch, rear-view mirrors folded back, the winners coasted downhill and putt-putted uphill at 20 to 30 mph, main bearings knocking. By contrast, I started late, and had to drive flat-out in order to catch a once-a-day ferry. And yet I averaged 46 mpg. That's still 4 mpg better than the EPA's rating for the diesel Rabbit and 5 mpg better than the Jetta Diesel EPA figure. Amazing.

The lesson? You don't need a homebuilt electric to save fuel—a stock VW diesel will do just fine. Based on my experience, average driving should yield between 50 and 60 mpg, with no conscious attempt to drive economically. That's better than any other car you can buy in America.

Volkswagen is receiving ever-stiffer competition from the Japanese, especially Honda, but to most people, the Rabbit remains the standard of excellence in the econobox ranks.

However, the Rabbit has also been around for over six years, and Volkswagen is running out of things to improve, short of going to a whole new body with more efficient space utilization, bigger windows and upgraded interior.

Instead, they're reduced to making minor changes. The standard Rabbit transmission is now a wide-ratio four-speed that's essentially a three-speed plus overdrive. Third



Roomy, elegant interior is available with leather seats, airconditioning, AM/FM stereo cassette and even electric-coil heated seats. Leather steering wheel is standard.



E (for efficiency) light on VW diesels blinks on to tell you when to upshift. According to Volkswagen, upshifting on cue from this light should improve mileage considerably.

gear is almost direct drive at 1.07 to 1, while fourth is a .70 overdrive (compared to last year's .91 fourth gear).

This doesn't have much effect on the diesel's EPA city fuel-economy figures, raised from 41 to 42 mpg, but the highway figure is now 57 mpg, and as we proved on our drive, these spectacular figures are actually conservative, if anything.

The Formula-E experiment

VW's other change is less worthwhile. If the EPA gives its approval for Volkswagen to advertise the gimmick, future Rabbits and Jettas will come equipped with an "economy light."

As any experienced driver knows, it takes more fuel to run an engine under heavy load at high revolutions than under a light load at low rpms. The VW "E-Light" is literally a light bulb in the instrument panel which tells you when to shift the manual transmission for optimum fuel economy.

The E-Light blinks on at a mere 2,200 rpm, but only at 70 percent throttle opening or less, and only in the lower gears under acceleration. In theory, shifting when the E-Light tells you to is worth 7 percent better fuel economy on the EPA city cycle. In real-world driving, I never saw the E-Light go on, because I was never under 2,200 rpm at part-throttle. But the rally team which achieved 80 mpg never saw the E-Light, either. They never went over 1,500 rpm.

Can the light help?

Would the blinking light help you save gas in everyday driving? I doubt it. But to find out, VW is test-marketing 2,000 Formula-E Rabbits

in Houston, Phoenix and Pittsburgh. If the owner response is positive, they'll petition the EPA to let them use 45 mpg city instead of 42 mpg city as the advertised fuel-economy figure.

If the EPA agrees, look for an industry-wide proliferation of dashboard lights, all claiming to give better gas mileage. If the EPA says no, even Volkswagen won't offer the E-Light. Personally, I'd rather have a tachometer.

Remarkably unremarkable

Since this is the first year for the diesel-powered Jetta, we paid it special attention. The most remarkable thing about it is how unremarkable it is. Except for that distinctive diesel clatter and leisurely acceleration, there's no driveability difference between the gas and diesel sedans. VW's new "quick-start" glowplugs have even eliminated the startup waiting period, the bane of conventional diesels.

The Jetta's diesel engine is virtually identical to the Rabbit diesel, but is a later series powerplant which has been more finely tuned for better economy. It displaces 1.6 liters (1,588 cc) and produces 52 hp at 4,800 rpm.

The Jetta is just a Rabbit with an add-on notchback trunk, a prettier grille and a fancy interior, but it feels like a whole different car—bigger, airier and more luxurious. At \$8,620 base, the five-speed Jetta Diesel isn't cheap, but there's also nothing else quite like it. And, of course, an honest 60 mpg will offset that high purchase price pretty quickly. Volkswagen expects to sell 15,000 of the new Jetta Diesels this year. I predict they'll have 15,000 very happy owners.—R.T.



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PM LOOKS AT A LIGHT-DUTY WELDING OUTFIT

Tote-Weld is a light-duty, easily portable outfit. Made by Mapp Products, a division of Airco Inc., the outfit weighs only 30 pounds, and has a sturdy plastic case with a comfortable handle.

Unlike many other welding rigs, this one is ready to use as soon as you connect the hoses and regulators. It comes with a 20-cu.-ft. refillable oxygen tank and a 1-pound Mapp gas disposable cylinder.

Mapp gas may not be as familiar to home workshopers as acetylene, but it has some important advantages. The gas smells—or more aptly, it stinks—so there's little possibility of a leak going unnoticed. Mapp gas cylinders are safe against shock. In the manufacturer's evaluation studies, full cylinders were dropped, hammered, and even blasted with dynamite, but none of the cylinders exploded, according to the company.

In my opinion, the best thing about Mapp gas is its wide availability and low cost. I bought a cylinder for \$5.49 at a local discount department store. Because the fuel is easy to get, I don't keep a large supply on hand.

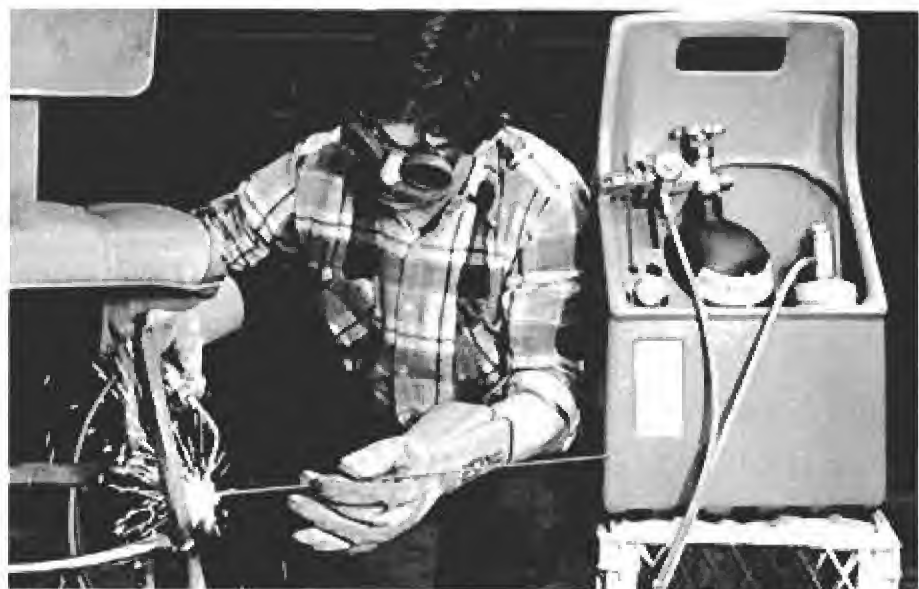
Putting the Tote-Weld through its paces proved that it can do the job despite its small size. As delivered, it can cut up to 3/8-in. steel plate and weld 1/2-in.-thick steel.

The Tote-Weld is carried by welding supply houses only. Check your classified directory for a dealer carrying Mapp products.

About \$200, the Tote-Weld includes torch, welding and cutting tips, tanks of oxygen and Mapp gas, regulators for each hose, spark lighter, goggles, brazing flux, rods and manual.

Caution: Normal welding safety rules should be followed.

—Bob Berger



Repairing broken leg support of a chair is a job easily handled by the Tote-Weld. The complete kit, including gas cylinders, comes in a sturdy plastic carrying case.



Torch is well balanced and has a comfortable grip. Oxygen is fed to work surface by pressing the button with your thumb.



Tool is used to make diagonal cut in angle iron. Kit includes cutting tips for slicing steel plate up to 1/2 in. thick.

PM LOOKS AT FIREWOOD CARRIER-HOLDER



Carrier (left), when loaded with firewood, simply fits into holder (right) that's stationed next to your fireplace or stove.

The Fetchit log carrier and Wood Kradle firewood holder are two attractive accessories to help you handle firewood. The Fetchit wraps around the wood so you can haul logs indoors without soiling your clothes or trailing in dirt and leaves. When inside, just lower the logs and carrier into the Wood Kradle. This setup holds quite a bit of



Sturdy fabric holds a healthy supply of wood. The dowel handles are removable.

wood and at the same time maintains a neat appearance around your fireplace or wood stove.

Both are made of sturdy, mildew-proof, 100-lb.-test fabric that comes in a warm brick color. And they're machine washable: The handles slide out of the carrier and the fabric is easily removed from the holder's metal frame.



Once it's indoors, you park the carrier in holder to corral the dirt and debris.

The Fetchit and Kradle are sold in sets identified by Kradle size. The regular, model No. RK, measures 12 x 14 x 22 in. and the large model, No. XLK, is 12 x 19 x 24 in. The two sets are \$15.95 and \$16.95 respectively and are shipped postpaid by R.C.S. Enterprises Inc., Box 925, Waynesboro, Va. 22980.

—Rosario Capotosto

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How to stretch your riding season

by Bill Hampton

Motorcycling is an *exposure* sport. It exposes you to cold, rain, dirt and large, hard bugs that don't like motorcyclists. You may even be exposed to spills and to collisions with other vehicles.

But with the right kind of protective aids, you can ride in almost any kind of weather. What's more, you'll stand a better chance of avoiding serious injury in the event you have an accident.

What should you wear?

Let's start with a good helmet. It's the most important piece of protective gear you can wear. Don't skimp here. Buy the best you can afford. For the safest coverage, you may want to go with the spaceman's model, which offers maximum facial protection. Whatever style helmet you decide on, make sure it's certified. Somewhere inside a good helmet is a label stating it meets or exceeds Z.90 or Snell standards.

When buying a helmet, make sure it fits well. Put it on and buckle up. Does it feel tight? A too-tight helmet will cut off circulation, affect hearing and transmit more shock to your head in the event of impact. But it should not fit loosely. Push up on the front of it. Does it tilt up and expose your forehead? If it does, it's too loose.

If your helmet ever receives a hard blow, as would occur during an accident, replace it, even if there's no visible damage. The shell could be weakened enough to fail later under another impact.

Eye protection

As with helmets, there are different styles of eye protection. Face shields are popular, as they provide facial protection, as well as eye protection. But air can still enter your eyes under turbulent-air conditions. A face shield is especially effective for avoiding the stinging effect of raindrops and large insects.

Goggles will do a better job of seal-

The right clothing will let you ride all winter long, at least until snow gets deep. The Yamaha all-weather riding suit shown here is wind- and waterproof to keep you dry and hold in body heat. Still, a suit like this must be worn with proper gear for head, hands, feet and neck.

ing the eyes from dirt and air turbulence.

For moderate-speed use, riding glasses are effective. Unlike dime-store sunglasses, riding glasses feature larger lenses. Although they don't offer the optimum coverage of goggles, they are more comfortable to wear.

Most forms of eye protection are made of plastic. In time they become scratched and refract oncoming headlight beams at night, especially when water droplets collect on the plastic. In damp weather, eye protection will fog, further restricting

vision. There are forms of eye protection available with a special chemical treatment known as Hydron bonding that absorbs moisture to prevent fogging; these Hydron polycarbonate lenses and face shields resist scratching and dust attraction.

As with a helmet, inspect any form of eye protection before you buy it. Hold it up to a light at arm's length and slowly move it back and forth to detect any optical irregularity in the material.

Many riders will consider the

(Please turn to page 200)



Cold-weather neck protection (above, left) is provided by Apple Warmers that stretch from riding suit to helmet. Honda gloves (above) are gauntlet type that keep cold air from going up your sleeves; they're warm and also protect your hands in a spill. Scot-Pro hand-grip guards (left) allow the use of lighter weight riding gloves.

Kid's coat rack is a snap to build

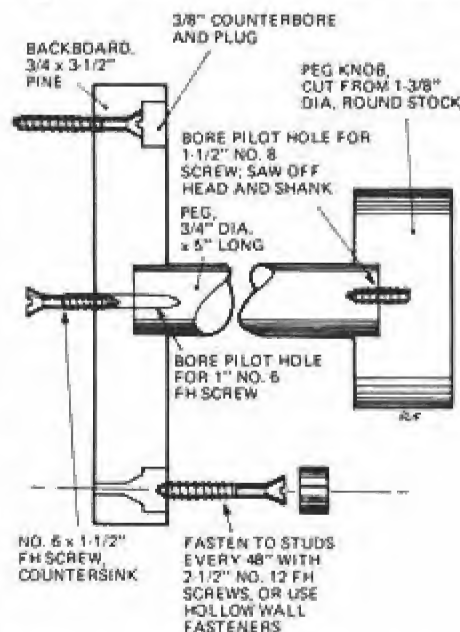


Rack hung within child's reach has large-diameter peg knobs (below) for safety.



To build this coat rack, cut 1x4 pine to suit the wall space in a child's room. Sand all edges smooth and mark holes about 15 in. apart. Bore 1/4-in.-dia. holes 3/4 in. deep and glue dowel pegs in place. For strength, secure pegs from behind the backboard with screws.

For knobs, cut 1 1/2-in. lengths of



1 1/2-in. round stock and bore 1/4-in.-dia. holes, 3/4-in. deep, in each; then paint. Bore pilot holes in dowels and knobs as shown. Install screws, cut off screwheads, apply glue and twist on knobs.—Joseph R. Provey

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YOUR MOTORCYCLE

(Continued from page 198)

leather jacket (not necessarily black) an important part of their riding attire. Leather offers warmth, along with protection against abrasion from spills. Its suppleness makes it conform to your body and without hindering movement.

When buying a jacket, make sure it fits well when you're in the *seated* position. The sleeves should be long enough to cover wrist areas when your arms are extended in a normal riding position. There should be some kind of wrist enclosure to keep



High-laced boots are the best type; they will not fly off in the event of an accident.



Use plastic, cardboard, newspaper in vulnerable areas if you haven't proper gear.

air from whistling up your arms. The back of the jacket should be long enough to keep air from sneaking up your back as you are riding.

Nylon alternative

An alternative to leather, preferred by many riders who want warmth and light weight, is a nylon ski jacket. Nylon has the added advantage of not "snagging" on the ground during a spill, as does leath-

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Full-frontal fairing, like this on BMW, provides best protection from the weather.

er or vinyl. Vinyl doesn't have the scuff resistance of leather, so it doesn't offer as effective protection should you be unlucky enough to take a slide on asphalt.

Complementing the jacket can be a pair of leather pants for cold-weather riding and abrasion protection.

In place of a jacket and riding pants, some riders prefer a one-piece riding suit.

Boots and gloves

Footwear should be high enough to at least cover the ankle areas. High-laced boots are preferable because they aren't dislodged in the event of a mishap. Slip-on boots are popular with many bikers, but they should be high and snug enough to stay on your feet should you take a tumble over the 'bar.

Don't overlook hand protection. Even in warm weather, gloves should be worn. They allow positive gripping of the controls and provide protection from abrasion during spills. For warm weather, a pair of leather or vinyl gloves can be perforated to allow circulation of air.

For cold weather, a pair of gauntlet gloves are ideal for keeping air from finding its way up the jacket sleeves. You can get additional insulation by wearing silk or nylon liners inside your gloves.

As a cyclist, you must learn to cope with cold. Even during summer

(Please turn to page 203)

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PM LOG SPLITTER

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PM LOOKS AT A KEROSENE HEATER



The heater's highly polished reflector radiates heat from the heating coil and wire net that is atop the chimney. The unit provides ample heat, and it does so in a hurry.



Two 1.5-v. batteries give ignition power to starter. These are housed at the rear.



When cartridge-type tank is lifted out for refilling, a valve in the screw cap automatically shuts off the kerosene flow.



Fuel gauge is in full view. It gives volume in tank by means of a red signal.



To light the heater, turn knob to ON position and press button to ignite the wick.

With all the hullabaloo over kerosene heaters, it seemed appropriate to test yet another unit. Some local codes, apparently, were written for equipment built in the '30s and '40s. The new family of kerosene heaters, in my opinion, mandates code revisions.

The unit shown here warmed an 18 x 18-foot garage/workshop on an evening when temperatures outside were in the teens. Although I didn't notice any smoke or soot during the trial, it is advisable to use an exhaust fan *with all kerosene heaters* for 10 minutes after turning a heater on or off. Because the flame consumes oxygen, you should also provide room ventilation. The Mark II shown here shuts off immediately if tipped over. It's the predecessor of the new Temp-Rite line whose prices range from \$183 to \$274. From Aladdin, Box 100255-P, Nashville, Tenn. 37210.

—H.W.

YOUR MOTORCYCLE

(Continued from page 201)

months, there are times when it gets uncomfortably cold on a motorcycle. Cold is sneaky: It can impair your reflexes, coordination and judgment so subtly you're not aware of what's happening. A good example is a rider on a long stretch of road. If cold has pulled away his body heat, he may be unaware that his senses have become sluggish. Up comes a sharp curve and he finds he can't react quickly. Off the road he goes. When the rider's body gets too cold, a kind of semihypnotic condition sets in.

Besides ambient—or normal—air temperature, the wind-chill factor and humidity content play important roles in determining your cold-tolerance levels and have a direct bearing on hypothermia (subnormal body temperature).

For instance, on a 70° F. day, a wind speed of 60 mph will drop the ambient temperature to 40°. Even on a 60° day, an airstream speed of 60 mph will cause a corresponding ambient-temperature drop to 25°. And if the temperature is 35°, a 60-mph cruising speed will drop the wind-chill temperature to a bone-chilling 0°.

Furthermore, if the humidity is high, the cold becomes even more uncomfortable and dangerous. Rain or fog will intensify the cold. When clothing becomes wet, it will lose as much as 90 percent of its insulating properties. And you don't have to get caught in a rainstorm to get wet, either. Just riding in a heavy fog when the air temperature is low will result in severe loss of body heat, if you're not dressed properly for the conditions.

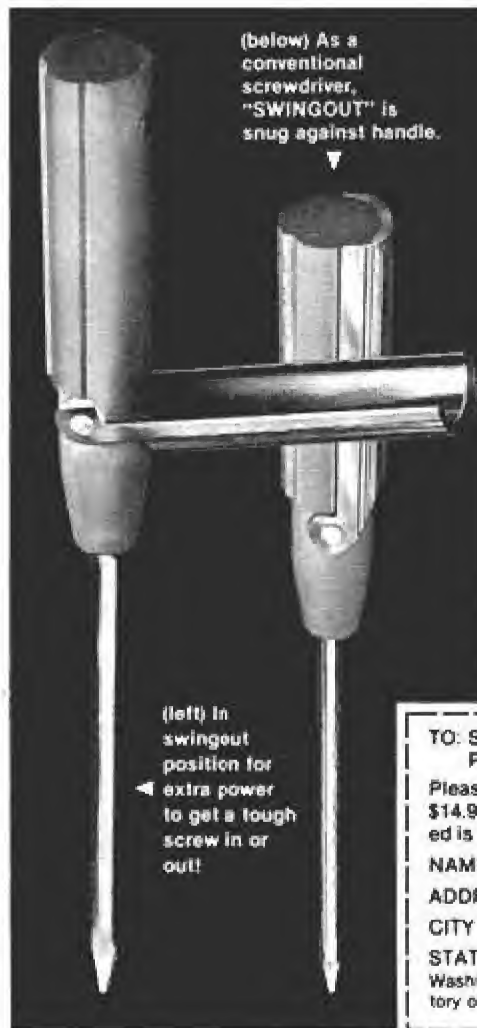
Keeping dry means you should carry a good rain suit with you to counter wet conditions. In fact, a lot of riders will wear their rain suits over their regular riding attire as an additional way to keep warm.

Windshields and fairings

Some weather-protective devices, like windshields and fairings, bolt onto your bike. But their effectiveness depends on their frontal area and aerodynamic qualities. For maximum protection, go for a full-frontal design. Small handlebar-mounted windshields and fairings can protect only the upper-body regions.

Whatever kind of protective gear you get for yourself, or for your bike, choose it carefully! After all, in most cases, it will serve a dual purpose of keeping you warm and saving your skin.

PM



(below) As a conventional screwdriver, "SWINGOUT" is snug against handle.

(left) In swingout position for extra power to get a tough screw in or out!

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HINTS FROM READERS

Plywood confines cut plugs



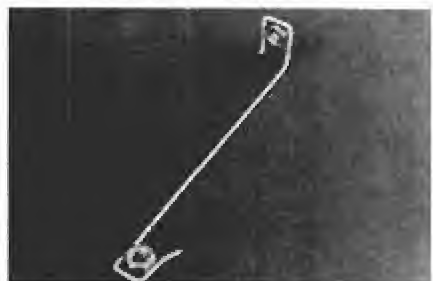
The usual way to make dowel plugs is to saw them off on a table saw after boring with a plug cutter. To keep the plugs from shooting off the table, place scrap plywood in the miter gauge groove opposite the point where the plugs are cut.—*C.E. Banister*

Balancing tailstock



The tailstock wheel on most lathes and wheels on other shop machines are unbalanced due to the metal handles; these turn to the bottom, causing unwanted boring and tool chatter. To prevent this, wrap ordinary wire solder (not acid or rosin-core) on a spoke opposite the handle to balance the wheel.—*Parry C. Yob*

Hard-to-reach bolts



When it's awkward to align a nut and bolt by hand, use an extender made from a wire coat hanger. If the bolt is inside an object, use the flat end of the wire; if the bolt is below reach, use the end of the wire with a right-angle bend.

—*Frank H. Day*

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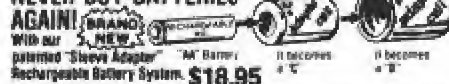


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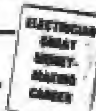
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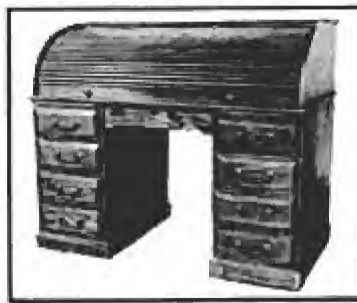


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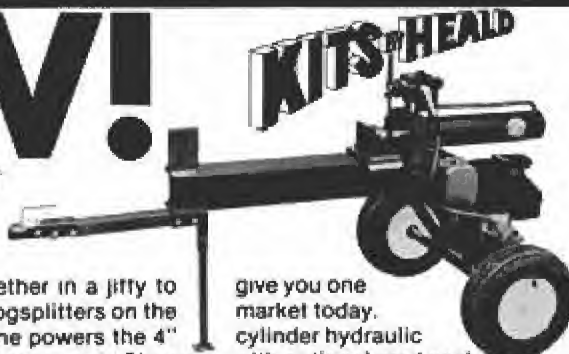
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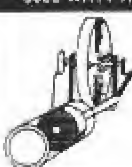
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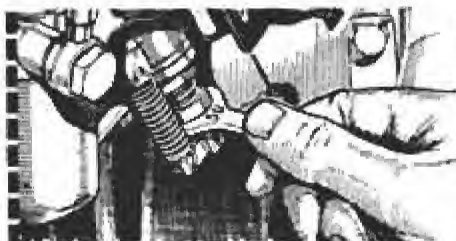
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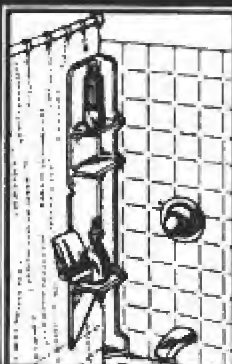
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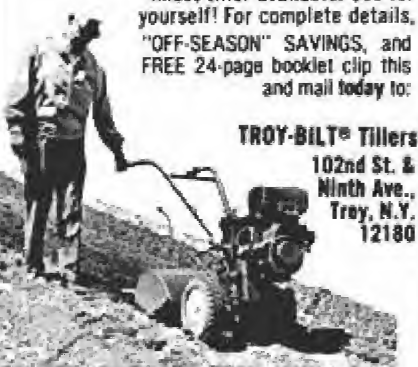
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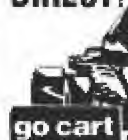
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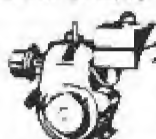


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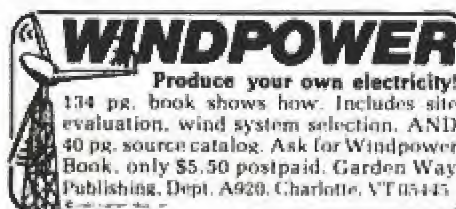
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STOP BURGLARS BEFORE they enter your home

Protect your Home and Business with this new micro-computer burglar alarm "FREE" for 30 days.

Burglars seek easy targets. Few have the daring or the knowledge to challenge the new Perim-A-Tron™ Home Security System. No other burglar alarm under \$2,000 can give you more protection...or match it for features that will give you and your family safety and peace of mind. For starters, it is wireless, installs in minutes, and is portable should you ever move.

THE BRAIN VS. THE BURGLAR

Perim-A-Tron's™ central console, or "BRAIN", employs a microprocessor, making it the most advanced security system available for consumer use. With Perim-A-Tron™ on duty, small sensors monitor doors and windows ready to signal the "Brain" from as far as 250 feet, in the event of a break-in attempt. The "Brain" processes each signal instantaneously and sounds not only a self-contained 85db internal alarm, but also a second 95db remote siren to augment the inside alarm or for placement outside to alert neighbors and police.

The Perim-A-Tron™ is so easy to live with that pets can come and go through partly-open windows or sliding glass doors without triggering it, yet so vigilant that an intruder will set it off before he can enter.

THOUSANDS OF OPTIONS

Perim-A-Tron's™ micro-computer lets you choose from thousands of three digit disarm codes. Only you know your code. But if your son's friend receives a "demonstration", you can easily change the code again...and again. You need no specially coded key which can be lost, misplaced, or stolen. The system even has two separate channels, each with its own distinct alarm sound. This feature allows you to zone your system. For example: Channel 1—house, Channel 2—garage, or Channel 1—doors, Channel 2—windows.

HOW IT WORKS

Operating the system is simplicity itself. When leaving, a light on the console tells you that you've armed the system properly, and have from 5 to 45 seconds to leave the house. This variable delay feature, not found on some expensive commercial systems, is selective so that it can apply only to frequently used doors. All other openings would be set for instant alarm. Upon returning home, you have ample time to turn the system off, thereby avoiding a false alarm.

If a break-in attempt occurs while you're away, an alarm memory light on the console tells you so. What's more, after sounding for



Perim-A-Tron's™ 20 button keyboard gives you protection a \$2,000 commercially installed system can't beat. Includes powerful remote horn.

10 minutes and scaring away the intruder, the system shuts off automatically and re-sets itself.

A CONSTANT GUARDIAN

Leave Perim-A-Tron™ in Test Mode during the day and it will signal when anyone leaves or enters. This thoughtful signal will not operate the remote horn but gives a 2 1/2 second warning on the internal speaker only.

If power fails (or is cut-off), the console has a battery back-up. And each battery powered transmitter/sensor will signal at the console if the battery runs low.

The Perim-A-Tron™ system is highly resistant to false alarms because it is not sensitive to motion or sound. Pets can roam at will, curtains can blow in a breeze, you or your children can visit the kitchen for a midnight snack—all without setting off an alarm.

COMING HOME SAFELY

There is nothing more frightening than finding a prowler lurking near your house when you arrive home at night. Our system's EXTRA PROTECTION DESIGN lets you carry a transmitter in your pocket, purse or glove compartment (it's about the size of a cigarette pack). With simple modification, it serves as a PANIC device and will set off the alarm at the press of a button.

COMPARE IT

Hard-wired "commercial" burglar alarms can cost \$2,000 PLUS a monthly fee (and you still never own it). Motion and sound detectors cost up to \$200 per unit and cover only limited areas. Your home may require two or three of these units and, in most cases, no alarm will sound until AFTER a prowler is inside for 30 seconds or more. Perim-A-Tron™ combines pre-entry protection with micro-electronic circuitry to provide the most protection at the lowest cost.

U.L. LISTED

The Perim-A-Tron™ Home Security System is listed by Underwriters Laboratories as a burglary protection device, a rating which goes beyond electrical safety. To earn this listing our alarm was thoroughly tested for critical burglary protection functions such as transmitter range, sound volume, battery back-up, keyboard component life, battery failure warning, and test function. This tough-to-get U.L. listing resulted from the exacting standards engineered into the Perim-A-Tron™.

YOU BE THE JUDGE

We urge you to order just the basic Perim-A-Tron™ system (pictured above) for a 30-day trial period. Use it to protect your family while you sleep and to protect your home while you're away. Then if you're not convinced that the Perim-A-Tron™ is the most advanced, efficient security system available today, return it undamaged for a complete, no-quibble refund—including return postage. You are protected by a 90 day manufacturer's warranty as well as Shelburne's 25 year reputation for satisfied customers.

HERE'S HOW TO ORDER

To order simply send your check for \$199.95 plus \$5.65 for shipping and handling to the address below. Credit card holders can speed delivery of their system by using our toll-free number listed below. We will then promptly ship your Perim-A-Tron™ unit complete with easy-to-understand instructions and decals warning that the premises are protected. Additional transmitters are available for \$29.95 each, but one is not required for every door and window. Instead, magnetic contacts can be purchased and easily connected to the transmitter, allowing you to cover additional openings for as little as \$5 each. The instruction booklet is quite useful in helping you determine the correct combinations to protect your home or office at the lowest possible cost.

Give yourself some peace of mind—order a Perim-A-Tron™ today at no obligation.

Maryland Residents add 5% Sales Tax.

CREDIT CARD HOLDERS—
CALL TOLL-FREE:

24 hours a day — 7 days a week

800-638-6170

OR

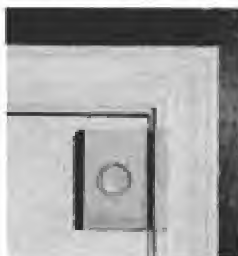
800-228-2606

Maryland Residents call 363-4304

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110 Painters Mill Road Dept. T-27
Owings Mills, Md 21117 (301) 363-4304



This photo shows a transmitter & magnet installed. If a break-in attempt occurs, the transmitter and magnet become separated triggering a wireless radio signal which activates the alarm. Installation takes only a few minutes and doesn't even require a screwdriver.



How to pick a pocket.

To prove a point, we stitched together half a pair of the best-selling jeans and half a pair of JCPenney Plain Pockets.

The point is, both feel great, fit great. They even look alike.

Till you look at the pockets. The best seller's have a little extra stitching. And that can cost you extra.

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11 mg. "tar", 0.9 mg. nicotine
av. per cigarette by FTC method.

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